THE RELATIONSHIP BETWEEN TECHNOPHOBIA AND TEACHERS' IMPLEMENTATION OF AN ELEMENTARY SCHOOL COMPUTER-ASSISTED INSTRUCTIONAL DELIVERY MODEL

By
MARY FOSTER KEATING

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This dissertation is dedicated to the teachers at Pioneer Elementary School, and their principal, without whose patience and cooperation this study would not have been possible, and to Dr. Charles H. Cline, Deputy Superintendent for Curriculum and Instruction, and Dr. William Fryar, Director of Research and Evaluation, Duval County School Board, under whose kind and supportive aegis the study was conducted.

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Mary Foster Keating

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The study was designed to examine the relationship of technophobia, as measured by three validated questionnaires developed by Rosen and Weil, and the degree to which a group of 13 teachers in a Jacksonville, Florida, elementary school were implementing IBM's Teaching and Learning with Computers (TLC) model. In addition to the questionnaires, case study methods, including semi-structured interviews, classroom diagrams, observations, and a review of documents were employed. In almost every case, teachers who scored in the No Technophobia category on the questionnaires were observed to be implementing the TLC concept fully, utilizing the computers well, integrating learning centers into their instructional style, and acting as facilitators with their students. These teachers were termed TCL-Oriented by the researcher. Teachers who scored in the Low or Moderate/High categories on the questionnaires tended to

utilize the computers differently, adopting a transitional style, which blended modified TLC methods with a more traditional teaching style. One teacher was identified as having a traditional style, in which little use was made of the computers, and whole group instruction continued to be the method of instruction. Despite intensive computer training, encouragement from their principal, and the availability of computers in the classroom, some teachers in this study continued to harbor anxiety about computers, and did not utilize them as often or as effectively as they might. Implications include a need for continued training and encouragement for anxious teachers, as well as a cautious approach to analysis of student achievement gains based on the use of computers, given that technophobic teachers may not utilize computers as effectively as others.

CHAPTER I
INTRODUCTION

Computers in American Society

Under the rubric of school reform, perhaps no single change in the way teachers teach and students learn has been as widely accepted by educators and the general public as the use of computers in the classroom. In the now prophetic words of Seymour Papert, who advocated the widespread use of computers by children, including teaching them how to write computer programs, "We are at a point in the history of education when radical change is possible, and the possibility for that change is directly tied to the impact of the computer" (1980, p. 36).

Computers have become an omnipresent reality of American life. People in businesses and industries rely heavily on computers in almost every aspect of their operation, and there are few business functions which have not in some way been impacted by the utilization of computers and computer-related technology. American companies spent an estimated $1 trillion on computer systems over the past decade (Meyer, 1995), and many believe that the computer revolution has only just begun. William Laberis, editor of Computerworld, reminded us that although Thomas Edison designed the first electric station in 1882, it was almost 40 years before American company officials began to convert from steam to electricity (in Meyer, 1995). Considering how prevalent computers already are, it is sobering to think that, relatively

speaking, computers are still in their infancy. The most astounding developments may be yet to come.

Computers in American Homes

Computers are also becoming more commonplace in American homes, but while the number of computers in homes is growing, computer ownership is sharply divided by race and family income. U.S. Census analysts reported that 43% of the heads of white households said that they own a computer, compared with 16% of African-American and 15% of Hispanic households; of families with an income of under $20,000, only 15% owned a computer, compared to 74% of families with an income of $75,000 or more (Kominski, 1991). This disparity between the computer "haves" and "have-nots" has prompted the invention of a new term, "the computer gap", to describe the fact that, "The United States is dividing into two societies--one that's comfortable with PC's, the other that doesn't have access" (Hancock, Wingert, King, Rosenberg, & Samuels, 1995).

Computers in American Schools

Schools officials are rushing to close the computer gap by purchasing computers for use by students, teachers, and administrators, and the number of computers in schools continues to rise annually. In 1983, the authors of the now-famous National Commission on Excellence in Education Report, A Nation at Risk, stated that computers were essential to the school reform effort and predicted that computing would be soon be treated as the fourth basic skill along with reading, writing, and arithmetic. That same year, the editors of Time magazine named the microcomputer the "Man of the Year," and respondents at 50,000 schools reported using computers, more than double the number reported just one year prior (Tucker, 1985). By 1981, a majority of secondary schools

owned at least one computer (Sutton, 1991), and by 1985, 93% of all secondary schools and 82% of all elementary schools offered some type of computer instruction (Becker, 1986; Naiman, 1988; U.S. Congress Office of Technology Assessment, 1987). In 1987 there were an estimated 1.7 million computers in public schools (U.S. Congress Office of Technology Assessment, 1988) , and by 1990 each secondary school was said to have nearly 45 computers, while each elementary school was estimated to have nearly 20 computers (Becker, 1991; Pelgrum & Plomp, 1991). Based on the 1983-89 growth rate reported in a survey of 1,416 schools, Becker (1991) projected that computers were being added to schools at the rate of between 300,000 and 400,000 new computers per year. In 1994, public schools spent $2.4 billion on technology, and the number of computers in public schools was estimated at 4.2 million (Merrow, 1995); by 1995 the number of computers in schools had risen to 5.2 million (Boysen, 1996). Clearly, educators have been acquiring computers at a steady rate for over a decade.

Background for the Study

Researchers have already conducted a good many studies having to do with the impact of technology on education, many of them focused on the role of computers in reinforcing or enhancing basic skills. These researchers, for the most part, have indicated that students learn at least as well and in some cases better when the material is presented on the computer (Boysen, 1996; Jamison, Suppes, & Wells, 1974; Jordan & Follman, 1993; Kulik, Kulik, & Bangert-Drowns, 1985; Niemiec & Walberg, 1985; Newman, 1993; U.S. Congress, Office of Technology Assessment, 1988; White, 1986).

While it is widely accepted that computers have the power to revolutionize the way teachers teach and students learn, it is not at all certain that the full potential of

technology in education has been realized (Bork, 1981; Papert, 1980; Walker, 1986; Weir, 1989). Swan and Mitrani noted that, "Unfortunately, there has been little empirical evidence to suggest that computers have produced noticeable changes in the suggested directions in traditional schooling" (1993, p.41). Several authors have concluded that simply putting computers in the schools will not effect substantive changes in the way teachers teach, and that technology alone cannot change education (Cuban, 1989; LaFrenz & Friedman, 1989; Pearlman, 1989). In rather stronger terms, Peck and Dorricott (1994) predicted that if computers were removed from businesses, work would come to a standstill across America, but that if all the computers disappeared from schools, education would be scarcely affected. Boysen suggested that, "Hypoallergenic chalk and simulated slate pass for technology innovations in schools stalled on the on-ramps to the information highway" (1996, p. 56).

Student Access to and Use of Computers

In census data for 1989, analysts indicated that 62% of white students in grades Pre-K through 12 had access to a computer at school, as did 52% of African-Americans and Hispanics (Kominski, 1991). A nationwide study of 24,000 public school students in grades 3, 7, and 11 by the Educational Testing Service produced disappointing data on students' use of computers. Although students' weekly use of computers was up strongly between 1983 and 1986, researchers who reviewed the data concluded that "in general, computers have not been integrated into the standard curricula" (Martinez & Mead, 1988, p. 35).

Recalling the fanfare surrounding inventions such as the film projector in 1896, "radio schools of the air" in the 1930s, television in the 1950s, and a plethora of 1960s

innovations, such as filmstrips, language labs, multi-media presentations, and early computers, one writer concluded that none of these early technological advances had much overall impact on teaching or learning. Moreover, he contended that, in many schools, where most of the computers have been relegated to administrative offices and computer labs, the teaching force remains technologically illiterate (Merrow, 1995).

In schools with high numbers of disadvantaged students, computers have been relegated to labs where they are used primarily with repetitive drill and practice programs for remediation of basic skills. In more affluent, suburban schools, students are more likely to use computers in more creative and expressive ways, exploring databases, spreadsheets, and drawing programs, and learning to use the research and communications resources available through the Internet (Becker, 1986; Merrow, 1995).

Compounding the problem of using computers in schools is the fact that many school buildings are not equipped for the 21st century. In a survey of about 10,000 schools nationwide, the staff of the United States General Accounting Office found that, overall, the nation's schools were not even close to meeting basic technology needs. Many schools lacked sufficient electrical wiring to handle the demands of computers, most did not use modern technology, and not all students--even those attending schools in the same district--had equal access to facilities (Morra, 1995). In all, "technology has been promising to revolutionize education for years, but none of these promises have been kept" (Merrow, 1995, p.52).

Teacher Training in the Use of Computers

Teacher training in the use of computers has also been the subject of concern. Researchers clearly indicate that in many cases teachers have not received the training

necessary to effectively implement computer-assisted instruction (Fredericks, 1984: Martin & Endreweit, 1985; Siegel, 1995; Smith & Anderson, 1994). And although teachers overwhelmingly agree that computers are a fact of life in schools and classrooms (Instructor Survey Results, 1991), teachers who responded to a 1994 survey conducted by three teacher magazines reported that their districts spent an average of only 8% of the technology budget on staff development (Siegel, 1995). Stasz , Winkler, Shavelson, Robyn, and Freibel warned that "the lack of adequately trained teachers presents a major obstacle to the effective instructional uses of computers" (1984, p. 3).

The use of computers in the classroom demands change on the part of teachers, including fundamental changes in the way teachers plan, organize, and deliver instruction. In addition, teachers must overcome any personal anxiety they may harbor about using computers (Poole, 1995). Although some authors remain unconvinced that computer anxiety is a valid psychological construct (Cambre & Cook, 1985), the vast majority of researchers indicate that fear of computers is very real to many teachers (Honeyman & White, 1987; Popovich, Hyde, & Zakrajsek, 1987; Rosen, Sears, & Weil, 1993; Rosen & Weil, 1995). Research in computer anxiety among teachers will be discussed more fully in Chapter II.

The assumption that all teachers are eager to use computers in their classrooms and that changes of this magnitude will encounter no resistance from teachers is an extremely naive one. As Rosen and Weil pointed out, "Simply putting computers into the schools will not make teachers use them as learning tools" (1995, p. 28). School-based leaders who believe that using their authority to mandate the use of computers in the classroom might also reflect on Saranson's observation that, "the evidence is rather

clear that although it is true that the principal is the gatekeeper in regard to the change effort, the ultimate outcome depends on when and how teachers become part of the decision to initiate change" (1991, p. 5). Indeed, to plan and try to implement change without consideration for teachers is unwise, for as Riel reminded us, "Plans to revolutionize schools without the direct involvement of teachers have not succeeded in the past and are unlikely to succeed in the future" (1994, p. 469).

Hall, Wallace, and Dossett (1973) specifically argued that the major reason for failure to implement innovation has been the lack of attention given to the persons involved in the change process. While school leaders rush to buy computers for classroom use, it is important to remember that teachers may vary in their interest, enthusiasm, comfort level, and experience with technology.

> Unless these real concerns of teachers' are seriously and systematically considered as a critical variable in the process of change, the use of computers by teachers will take on the usual "hit and miss" orientation so typical of innovations that educators effectuate. For innovation to be successfully implemented, attention must be given to the *involvement* of individuals in the *change* process, for change will occur only when individuals change. (Cicchelli & Baecher, 1985, p 56)

Oddly, relatively few researchers have focused on teachers attitudes toward computers as a variable which may affect the success or failure of computer-assisted instruction. Instead, the majority of research studies have been media comparative, with the result that "medium was confounded with instructional method and content" (Clark, 1984, p. 3). The tacit assumptions in studies which focus solely on the medium have been that (a) all teachers in the studies were enthusiastic, knowledgeable computer users, and/or that (b) all teachers in the studies implemented the program exactly as

recommended or designed, and/or that (c) computer-assisted instruction was "teacher proof."

Purpose of the Study

The purpose of this study was to describe the implementation of a computer-assisted instructional delivery model by a specific group of teachers and to establish whether a relationship existed between the way each individual teacher implemented the new program and the degree of technophobia, or computer anxiety, evidenced by each of them. Case study methodologies were used to focus on a schoolwide reform effort which took place in an urban Florida elementary school to which district level administrators had diverted approximately $250 million dollars in general operating funds, state technology enhancement funds, and federal Title I moneys to implement the IBM Teaching and Learning with Computers (TLC) model. During the 1994-95 school year, the school was completely retrofitted, a Local Area Network (LAN) with a generous array of instructional and productivity software was installed, each classroom was equipped with four to five IBM computers, and the first group of nine teachers received 60 hours of TLC training.

The study focused on the attitudes and behaviors of the teachers as they began to implement the new model, which for many of them represented a change in teaching style and, in some cases, content of instruction. The study describes the attitudes and computer experience of each of the teachers, and utilized a validated questionnaire to measure the degree to which technophobia, or computer anxiety, was present. Classroom observations and interviews with the teachers were used to assess the degree to which teachers were actually implementing the model and to determine whether a relationship

existed between teachers' technophobia as measured by the questionnaire and the degree of implementation.

Statement of the Problem

The problem in this study was to gain knowledge that may be useful in implementing computer-assisted instructional delivery models in elementary schools. At the school level, implementation of computer-assisted instructional delivery is often less than optimally successful. One possible explanation has been offered by Rosen and Weil (1994), who contended that unsuccessful implementation may be related to the failure to take into account the possible effects of teachers' technophobia on program implementation.

Technophobia, as defined by Rosen and Weil, is a multidimensional anxiety state, evidenced by one or more of the following:

> 1. anxiety about present or future interactions with computers or computer-related technology;
> 2. negative global attitudes about computers, their operation or their societal impact; and/or
> 3. specific negative cognitions or self-critical internal dialogues during actual computer interaction or when contemplating future computer interaction. (1992, pp. 7-8)

The three dimensions of technophobia, as defined by Rosen and Weil, were measured in this study using three questionnaires: The Computer Anxiety Rating Scale (CARS) (Form C); the Computer Thoughts Survey (CTS) (Form C); and the General Attitudes Toward Computers Scale (GATCS) (Form C) (Rosen & Weil, 1992).

The problem was addressed through a case study of classroom teachers at Pioneer Elementary School in Jacksonville, Florida, an urban elementary school in which the IBM Teaching and Learning with Computers (TLC) model was being implemented

schoolwide. Rosen and Weil's set of three technophobia questionnaires were administered to ascertain whether and to what extent this group of elementary teachers harbored anxiety toward computers and computer use. Drawing from data collected from structured interviews, classroom observations, and a review of documents, teachers' attitudes and behaviors toward computers were analyzed to determine whether a relationship existed between teachers' technophobia and their implementation of the computer-assisted instructional delivery model.

Research Questions

The study was designed to systematically explore the relationship of technophobia to teachers' implementation of an elementary school computer-assisted instructional delivery model. Three guiding questions provided the framework for this study:

1. What is the relationship between teachers' scores on the CARS (Form C) and the extent to which they implemented the TLC model?

2. What is the relationship between teachers' scores on the CTS (Form C) and the extent to which they implemented the TLC model?

3. What is the relationship between the GATCS (Form C) and the extent to which they implemented the TLC model?

Significance of the Study

Cronbach and Suppes (1969) divided the world of research into two different types: Conclusion-oriented and decision-oriented. This study involved the latter, and was designed along lines suggested by Cooley and Bickel, who called such studies "decision-oriented educational research"(DOER). The research was ". . .designed to help educators as they consider issues surrounding educational policy, as they establish

priorities for improving educational systems, or as they engage in the day-to-day management of educational systems" (1986, p. 3).

Educational leaders at both the school and the district level are called upon to make decisions which not only represent significant changes in the teaching and learning process, but which also involve the expenditure of considerable sums of money. The purchase of computers, software, peripherals, and extensive teacher training represents a tremendous outlay of money for most schools, and a decision not lightly made (Langhorne et al., 1989). This study provides a detailed description of the implementation process as experienced by the individuals most directly involved: the teachers. The results may provide district and school administrators with a basis for decision-making in the areas of planning, purchasing, teacher training, and staffing.

The wide-spread use of computers in American society is an omnipresent reality with clear implications for education. However, despite the purchase of millions of dollars in computer equipment, and widespread acceptance of the fact that students must become proficient in the use of computers in order to succeed in the high-technology, Information Age society of the 21st century, computers have made surprisingly little impact on traditional instruction. As D'Ignazio (1993) described it, while businesses have been building electronic highways, education has been creating an "electronic dirt road."

This study was designed to closely examine one of the most human elements in computer-assisted instruction, the teachers, to discover the extent of their anxiety toward computers and computer use and whether this technophobia was related to the way in which they implemented the IBM TLC model.

Limitations

The following are the limitations of the study:

1. The study was conducted during three weeks in May, 1995. Thus, only the effects that materialized during that time interval were included.

2. During the time interval in which the study was conducted, only teachers in Grades K-3 (n=9) had participated in 60 hours of IBM TLC training and had operational, networked computers and other teaching materials at their disposal. These nine teachers, who are referred to as Phase I teachers throughout the study, are therefore the main focus of the study, and data collected from all of them were included. During the same time interval, Phase II teachers (teachers of Grades 4 and 5) had received some computer equipment and all or part of the teaching materials, but in each case they had only had the computer equipment and teaching materials for a few months. In addition, the Phase II teachers had also only participated in approximately 20 hours of training. Because Phase II teachers were not yet fully implementing the TLC model at the time of the study, data from only two, randomly selected Phase II teachers were included. Phase III teachers (teachers of Exceptional Student Education students) had received neither computer equipment, nor teaching materials, nor training at the time of the study, and were also not yet implementing the TLC model. Therefore, data collected from only two, randomly selected Phase III teachers were included.

3. The study is a case study, and as such is not generalizable to schools with similar student or teacher populations. The extent to which the study's findings apply to other situations is left up to the reader or user. "It is the reader who has to ask, what is there in this study that I can apply to my own situation, and what clearly does not apply?"

(Walker, 1980, p. 34). External validity and generalizability will be discussed in greater detail in Chapter III.

Definitions

Teaching and Learning with Computers (TLC) refers to an instructional model developed by the International Business Machines (IBM) Corporation, Educational Systems Division. The TLC model utilizes IBM computers and courseware in a learning center environment and emphasizes the role of the teacher as a constantly moving facilitator of instruction..

The TLC-oriented classroom is defined in this study as a classroom in which the arrangement of furniture and computer equipment, the presence of learning centers throughout the room, and the observed actions and movements of the teacher in the role of facilitator indicate that the TLC model is operative.

The transitional classroom is defined in this study as a classroom in which the arrangement of furniture and computer equipment, the presence of some learning centers in addition to traditional rows of student desks, and the observed actions and movements of the teacher in a role other than that of a facilitator of instruction indicate that the TLC model is only partially operative.

The traditional classroom is defined in this study as a classroom in which the arrangement of furniture and computer equipment, the absence of learning centers and presence of traditional rows of student desks, and the observed actions and movements of the teacher in a role other than that of a facilitator of instruction indicate that the TLC model is not operative.

Technophobia is defined in this study as a multidimensional anxiety state, evidenced by one or more of the following: (a) anxiety about present or future interactions with computers or computer-related technology; (b) negative global attitudes about computers, their operation or their societal impact; and/or (c) specific negative thoughts or self-critical internal dialogues during actual computer interaction or when contemplating future computer interaction (Rosen & Weil, 1992). For purposes of this study, in which computers and peripheral equipment (*e.g.,* printers) were the primary type of technology being studied, technophobia is synonymously referred to as computer anxiety.

Teacher training is defined as organized instruction given to practicing teachers. In this study, the teacher training referred to is TLC training, delivered by IBM-trained instructors.

Learning centers refer to areas within a classroom, set aside for specific, teacher-designed, small group learning, e.g., a listening center, consisting of a table and 4-6 chairs, a tape recorder, audio tapes (with or without accompanying books), and headsets for 4-6 students. Learning centers may be set up with activities in any subject and are limited only by the imagination of the teacher.

The following chapter is a review of literature which has a bearing on this study. It contains a description of the IBM TLC model being implemented in this case study and summarizes the results of evaluation studies which have been conducted on IBM's most popular computer software programs, Writing to Read and Writing to Write, which are the centerpieces of TLC. The chapter also contains a review of the literature on

technophobia, or computer anxiety, focusing on studies of correlates to technophobia as well as studies of teachers' attitudes toward computers.

CHAPTER II
REVIEW OF THE LITERATURE

The purpose of this study was to gain knowledge that may be useful in implementing computer-assisted instructional delivery models in elementary schools. The study was designed to systematically explore the relationship of technophobia to teachers' implementation of a computer-assisted instructional delivery model by examining the attitudes and behaviors of a specific group of public school teachers during the implementation phase of IBM's Teaching and Learning with Computers (TLC).

The review of the literature begins with a description of the TLC model, as well as the results of research carried out on IBM's primary software programs, Writing to Read and Writing to Write, programs which are the centerpiece of the TLC model. These sections are followed by a discussion of the nature of anxiety in general and an examination of computer anxiety, or technophobia, in particular. Research which deals specifically with teachers' anxiety toward computers, as well as their general attitudes toward computers, make up the final sections.

The Teaching and Learning with Computers (TLC) Model

IBM's Teaching and Learning with Computers (TLC) is an instructional model designed for use in the elementary school classroom. It was developed by IBM's Educational Systems group and piloted in 1988 in several school districts, including the

Pekin, Illinois, schools. In an article describing the experience of second and fourth grade teachers and their students from Willow Elementary School in Pekin, who were the first to try the new model, Principal John Emory stated, "The teachers at Willow Elementary are enthusiastic about TLC. This enthusiasm extends even to those teachers who are not directly involved in TLC's use, but find ways of applying it in their own classrooms" (IBM, n.d.a. Application Brief).

IBM representatives have been quick to point out that TLC is not a program; it is a model or concept. The TLC model brings computers into the classroom, for use "at the point of instruction" (International Business Machines Corporation, 1991, 1995). The developers recommend that each classroom be equipped with four or five networked IBM PS/2 computers (or one computer for every four students), each with a minimum 386 processor and 4MB of RAM, a mouse, one of several audio adapters, an SVGA monitor, and a CD-ROM drive. It is also recommended that each classroom have a networked teacher station for the teacher's own use. This station may be used for word processing, desktop publishing, grade recording, etc., and may also be used as a presentation tool, if a large screen monitor or projection device is available (IBM, n.d.b. Training Manual, TLC K-6).

The computers must be networked to a network file server which has at least 8MB RAM (16MB recommended), a minimum of 400MB fixed disk space, monochrome or color display, and a CD-ROM drive. Although the computer network is not absolutely essential to the TLC model, it is highly recommended, because the network file server enables teachers and students to have easier access to programs, stores all student data,

and generates reports to monitor student progress. Practically speaking, the use of a network file server also saves wear and tear to program diskettes and makes the same programs available to every teacher.

Not surprisingly, IBM recommends its own software for installation on the network server. The core of the software bundle recommended by IBM consists of some of its best known programs: Writing to Read (K-1); Writing to Read 2000 (an update of the original Writing to Read); Writing to Write (Grades 2-5); Stories and More I and II (K-2); Math and More I and II (Grades 1-2); Exploring Math Concepts Level 1 (K-2); and The Nature of Science (K-6). While these are examples of software that supports the TLC model, school personnel are not limited to these choices. Other IBM programs, as well as network versions of other manufacturers' software, may be selected and installed for use with TLC.

IBM representatives provide teacher training and publish extensive teacher guides and instructional kits to complement TLC. The number of training days needed by any particular school or teacher depends on the courseware the school staff has decided to install on the network. Training focuses first on the use of the network, during which teachers learn how to log on, select programs for their students to use, and to "set up" their students, so that students can access programs selected by the teacher. Subsequent training focuses on thematic, cross-curricular instruction, integrating the software into the district curriculum, and setting up the classroom for small group, learning center instruction.

The developers of the TLC model stress the use of an active learning environment, in which the teacher constantly moves around the room and acts as a facilitator of instruction. Typically, the classroom is divided into areas where small groups of students may work, called learning centers. Students move from one learning center to the next at a signal from the teacher. One of the TLC learning centers is comprised of four or five computers. Another area may be designated for pre-computer activities, where students can prepare for and/or discuss the work they will be doing at the computer, while still another area may be set aside for post-computer activities, where students analyze what they have just done at the computers. Teachers are given flexibility to design learning centers as they like. Thus the number of learning centers in a TLC classroom could vary upwards from the minimum of three to almost any number the teacher wants to create (IBM n.d. Training Manual, TLC, K-6).

Although whole group instruction may also be used, it is not the main instructional strategy in a TLC classroom. Instead, the teacher is encouraged to explain what is to be done to the whole group, then assign small group activities at the various learning centers. The amount of whole group instruction thus may also vary from classroom to classroom. Grouping of students is also left to the discretion of the teacher. Students can be grouped heterogeneously or homogeneously, and the teacher can change the groups at any time. Students work alone or in pairs at the computer, and peer interaction at the computers is highly encouraged. Teachers are encouraged to incorporate their own favorite activities, either in the learning centers or during small group or whole group instruction.

In summary, proper implementation of the TLC model demands change on the teachers' part. First, teachers have to overcome any anxiety they might have harbored regarding computers. Second, the training they receive has to be put into practice, and the materials and equipment supplied to them have to be put to use. Third, they have to integrate the type of small group, facilitative, learning center instruction which is integral to the TLC model into their own instructional style. The TLC model is designed to outline for teachers the basic concept of small group instruction in which computers are one of several learning centers and give them the flexibility to build upon the basic concept.

Writing to Read and Writing to Write

The centerpieces of the TLC model are IBM's best known and most widely used software programs: Writing to Read (WTR), designed for Grades K and 1, and its sequel, Writing to Write (WTW), designed for Grade 2. Writing to Read was developed in the mid-1980s by John Henry Martin (Martin & Friedberg, 1986) and has been widely used, especially in urban school systems, such as Baltimore, Tulsa, and Nashville. The principal purpose of the two software programs is to improve reading and writing performance. Writing to Read students move among five work areas (or learning centers), working on computers to learn phonics skills, writing stories on computers, electric typewriters or with paper and pencil, and listening to taped stories (Martin & Friedberg, 1986). IBM has supported evaluation of Writing to Read, published an evaluation guide (International Business Machine Corporation, 1986), and commissioned a large scale evaluation of numerous WTR sites by the Educational Testing Service

(Murphy & Appel, 1984). However, the results of early research studies on the effects of these programs were not encouraging. Robert Slavin, who reviewed 29 separate evaluations of WTR programs in 22 different school districts, concluded that

> First, there is no evidence to suggest that Writing to Read has a positive effect on the reading achievement of first graders, even if they have also been in the program in kindergarten. . . .Second, there is no evidence to suggest that any effects of Writing to Read on reading achievement can be detected after the year in which students were in the program. (1991, p.8)

Slavin pointed out, however, that standardized tests administered to children of such a young age are not as reliable and valid as might be hoped, and he suggested that careful long-term evaluation of the program continue.

Several studies conducted since Slavin's review have contained somewhat more impressive results. One of the most thorough evaluations of WTR was a statewide study conducted by researchers from the University of Mississippi. In 1989, education officials in the State of Mississippi, with funding from the state legislature and two private foundations, made a commitment to utilize WTR to teach all first graders in 27 experimental schools. School personnel were invited to write a letter of interest, and the experimental schools were chosen at random from among the applicants. Each of the experimental schools received a WTR computer laboratory, and the schools' administrators in turn promised to maintain and utilize the laboratory to teach all first graders with WTR for at least five years. Later, 9 of the 27 experimental schools opted to add WTW as the method of instruction for their second graders Statewide supervision and strict implementation guidelines were instituted in each of the experimental schools (Chambless & Chambless, 1993).

After one year, a statewide, longitudinal evaluation began, in which writing samples and standardized tests scores of students in randomly selected WTR schools were compared with the same types of data collected from students in control schools in which WTR and WTW were not available. Student writing skills, as well as achievement in reading, language, and spelling, as measured on the Stanford Achievement Test (SAT), were analyzed across six racial, gender, and socio-economic strata: Low Socio-Economic Status (SES) African-American Males; Low SES African-American Females; Low SES White Males; High SES White Males, Low SES White Females; and High SES White Females. In every group, students who used WTR in Grades K-1 performed significantly better in second grade that students who received only traditional instruction in Grades K-1. In every group, students who used WTR in grades K-1 and WTW in Grade 2 performed significantly better in second grade that students who received only traditional instruction in grades K-2 (Chambless & Chambless, 1993).

A similar study was conducted in 1990 in six school districts located in the Simi Valley area of California, with one important difference: Computers were placed in 29 classrooms rather than in computer laboratories, and teachers who participated in the program did so on a voluntary basis. Students in WTR classrooms averaged at least two writing levels higher than those in the control group, based on a holistic rubric developed by the Educational Testing Service. Parents of students in the experimental classrooms reported significantly higher evidence of writing and reading behaviors at home, such as observation of their children writing stories, than parents of children in the control group (California State University, n.d.). Because the teachers who participated in this study

did so on a voluntary basis, however, it is difficult to know whether the effects on student achievement were due solely to use of the WTR program, or to the efforts of enthusiastic, self-starting teachers.

The Appalachian Regional Commission, in cooperation with IBM, implemented WTR over a three-year period in 55 selected rural elementary schools in the Appalachian regions of Kentucky, Virginia, and West Virginia. Project schools were selected because they had no computers and students had low achievement scores. In three years, over 7,000 students were served. In their final reports on the project, researchers reported that WTR students performed significantly better than non-WTR students on writing and spelling assessments (Childers, 1990; Childers & Leopold, 1993).

Although it can be argued that early results were disappointing and the results of each of the three major evaluations mentioned above were flawed, the positive results on WTR on student achievement were nonetheless promising enough to warrant improvements to the programs and continued marketing by IBM.

The TLC model was designed to optimize the use of WTR and WTW by giving students the opportunity to use the programs daily in their classrooms, in small group settings. The focus of the evaluation studies conducted thus far has been on student achievement, measuring student gains in writing and reading, and comparing the achievement of students who received instruction using WTR and WTW with the achievement of comparable students who received traditional instruction. No research studies, however, were identified which determined how well, how uniformly, to what degree, or indeed whether or not, the teachers actually implemented the model.

The Nature of Anxiety

Although history may eventually define anxiety as a phenomenon most closely associated with the twentieth century, it is by no means exclusively modern. The eleventh century Arab philosopher Ala ibn Hazm asserted that anxiety was inherent in human existence and that, "no one is moved to act or moved to speak a single word who does not hope by means of this action or word to release anxiety from his spirit" (in Kritzeck, 1956, p. 573).

Sigmund Freud identified anxiety (Angst) as a discrete clinical syndrome in 1894, and made important contributions to the understanding of the nature of anxiety (Spielberger, 1966). He conceptualized anxiety as a signal indicating the presence of danger, and delineated it into two distinct types: objective (or external) and neurotic (or internal). Since Freud's time, the concept of anxiety has been the subject of much study and discussion, up to and including modern studies, which include a new type of anxiety caused by the pressure for change brought on by technological advances (May, 1950).

Freud's definition of anxiety as a two-part concept endures today, albeit in modified form. Cattell and Scheirer (1961), in factor analysis studies, defined the two types of anxiety as state and trait. Trait anxiety is chronic and is defined as a personality-related proneness to be anxious (Philips, Martin, & Meyers, 1972). State, or situational, anxiety is a condition that fluctuates, and may respond to treatment. Speilberger, who used and refined this concept, described state anxiety (A-state) as a:

> . . . transitory emotional state or condition of the human organism that varies in intensity and fluctuates over time. This condition is characterized by subjective, consciously perceived feelings of tension and apprehension, and activation of the autonomic nervous system. Level of A-State should be high in circumstances

> that are perceived by an individual to be threatening, irrespective of the objective danger. (1972, p. 39)

Spielberger conceptualized trait anxiety (A-Trait) as referring to:

> relatively stable individual differences in anxiety proneness, that is, to differences in the disposition to perceive a wide range of stimulus situations as dangerous or threatening, and in the tendency to respond to such threats with A-State reactions. A-Trait may also be regarded as reflecting individual differences in the frequency and the intensity with which A-States have been manifested in the past, and in the probability that such states will be experienced in the future. (1972, p. 39)

According to trait-state anxiety theory, the cognitive appraisal of a stimulus as threatening evokes an anxiety state reaction. Persons with a high A-Trait will perceive situations as more threatening than will persons with low A-Trait. The reaction to a threatening situation, widely known as the "fight or flight" response, may initiate behaviors designed to avoid the situation or defense maneuvers to reduce the level of A-State intensity. The type of stimuli which are perceived to be threatening are cognitively perceived by individual differences in A-Trait (Spielberger, 1972). The trait-state anxiety theory is widely used by researchers for purposes of measuring anxiety.

The Nature and Definition of Computer Anxiety

Computer anxiety is a specific anxiety manifestation. As early as 1963, computer anxiety began to be studied. In a large nationwide sample of popular beliefs about computers, Robert Lee, a social psychologist at IBM, found that people held both positive and negative views of the new invention (Lee, 1970). The phenomenon has since been given several names, including computerphobia (Jay, 1981), technostress (Brod, 1984),

cyberphobia (Rice, 1983), computer aversion (Meier, 1985), technophobia (Frideres, Goldenberg, Disanto, & Fleming, 1983), and computer anxiety (Raub, 1982).

Several definitions of computer anxiety have been developed. Powers, Cumings, and Talbott (1973) defined it as a combination of physiological symptoms, characterized by changes in systolic blood pressure, diastolic blood pressure, heart rate, and electro-dermal response. Raub defined computer anxiety as "the complex emotional reactions that are evoked in individuals who interpret computers as personally threatening" (1981, p. 9). Rohner and Simonson defined it as "the mixture of fear, apprehension, and hope that people feel when planning to interact or when actually interacting with a computer" (1981, p. 551) and suggested that because of these feelings, many people choose to avoid using a computer when given a choice.

Mauer and Simonson defined computer anxiety as "the fear and apprehension felt by an individual when considering the implications of utilizing computer technology" (1984, p. 2). They observed that it is possible for people to fear using a computer, even when the computer poses no immediate threat.

Kay (1993), on the other hand, who felt that attitudes toward computers included not only anxiety but a composite of various constructs, attempted to develop a more complete measure with which to assess attitudes toward computers, and argued that until a common metric is developed, research results would continue to be inconclusive. The resulting Computer Attitude Measure (CAM) was based on four principal constructs: cognitive, affective, and behavioral attitudes, and a dimension of perceived control. Kay's four constructs, as well as the CAM survey items, bear a striking similarity to the

attitudes being measured by Rosen and Weil (1992, Form C). In both the CAM and the three-instrument questionnaire first developed by Rosen and Weil in 1988 and utilized in this study, attempts were made to ascertain what respondents think about when they use or contemplate using computers, what respondents feel when they use or contemplate using computers, how respondents feel about computers in general, and how they feel about the ways in which computers are used in society. Despite Kay's contention that the CAM represents breaking new ground in measuring attitudes toward computers, the fact remains that survey items in the CAM are very similar to those of Rosen and Weil.

Rosen, Sears, and Weil (1993) defined three specific types of computerphobics: anxious computerphobics, cognitive computerphobics, and uncomfortable users. Anxious computerphobics display classic physiological signs of an anxiety reaction when faced with computer interaction, including sweaty palms, headaches, and heart palpitations. Cognitive computerphobics, in contrast, appear calm, but are being mentally inundated with a rapid series of negative thoughts that they will somehow fail, ruin the computer, or be embarrassed in front of others who know how to use computers. Uncomfortable users include those who are somewhat anxious and who lack information and computer skills, but who do not display the symptoms or behaviors of anxious computerphobics and cognitive computerphobics.

Cambre and Cook (1985) reviewed the definitions of computer anxiety and summarized the following points which were common to all the theories:

1. Studies indicate that some people evidence fear of using computers. This fear is most commonly called "computer anxiety."

2. Emotional reactions may be triggered by actually interacting with a computer or by merely planning or anticipating interaction with a computer.

3. Computer anxiety is an anxiety state and can be changed over time.

Studies of Computer Anxiety

Many researchers have tried to find answers to the question of why persons are anxious about using computers. Research in computer anxiety may be divided into two broad categories. The first category deals with investigation of possible correlates, including a variety of studies which measured computer anxiety before and after a specific intervention (usually some sort of computer course or training experience), in order to ascertain whether the level of anxiety was reduced. However, as Maurer observed in his excellent review of the literature on correlates to computer anxiety, "Much of the research in this area is significantly flawed, making it difficult to support any particular claim" (1994, p. 369).

Reasons for the difficulty in making generalizations based on the research included lack of uniformity in definition, causes, and measurement. In the words of Cambre and Cook, "Despite the large amount of anxiety research reflected in the literature, the construct still defies theoretical and methodological consensus" (1985, p. 38). Another problem was that while most instruments have undergone psychometric testing, Szajna reminded us that ". . . very few have been analyzed for predictive validity" (1994, p. 926).

Despite the problems attendant to the definition of computer anxiety, a number of instruments have been developed to measure the construct, some designed for use in

particular studies (Kernan & Howard, 1990; Loyd & Gressard, 1984), others developed for wider use (Kay, 1993; Raub, 1981; Reece & Gable, 1982; Rohner & Simonson, 1981; Rosen & Weil, 1992).

Correlates of Computer Anxiety: Previous Experience

Two of the most logical predictors of computer anxiety are previous experience and training in the use of computers. A number of studies have sought to establish a relationship between computer experience and some measure of technophobia (Dwyer, Ringstaff, & Sandholtz, 1991; Dyck & Smither, 1994; Hayek & Stephens, 1989; Jones & Wall, 1985; Koohang, 1987; Loyd & Gressard, 1984a; Marcoulides, 1988; Rosen & Weil, 1995). While common sense would seem to dictate that computer experience much be related to computer anxiety, none of these researchers was able to prove with absolute certainty that there was a cause and effect relationship between computer experience and technophobia, even though some have been erroneously referenced as having done so (Maurer, 1994).

Marcinkiewicz (1994) developed a Level of Use Scale which divided computer usage into three levels: nonuse, utilization, and integration. When the Level of Use Scale was used in surveys of 167 preservice and 170 practicing teachers, Marcinkiewicz found that preservice teachers expected to use computers in their classrooms, while practicing teachers' expectations differed widely.

Honeyman and White (1987) studied teachers and school administrators enrolled in introductory computer applications courses and found that anxiety levels among those with no previous experience did not begin to abate until they had had approximately 30

hours of training. Computer anxiety, however, does not always abate with time. In a survey of teachers' attitudes before and after using computers in a Texas elementary school for a year, Davidson and Ritchie found no significant change in the teachers' attitudes toward computers. Although the vast majority of the teachers were positive in their opinion of computers as a valuable teaching tool (85% in 1991 and 94% in 1992), fully one third of the teachers still felt uncomfortable around people who were knowledgeable about computers and worried that they might do something wrong and break or damage the computer. In contrast to the teachers, students' and parents' attitudes had changed markedly for the more positive over the same period of time (1994, p. 16).

Rosen and Maguire (1990) concurred that past experience was inversely related to computer anxiety, but stressed that computer experience alone does not cure computer anxiety. In their study, the negative attitudes toward computers held by computerphobics caused them to actively avoid the use of computers whenever possible. When forced to interact with computers, ". . . computerphobics take more time, make more errors and perform more poorly than non computerphobics. Rather than "curing" their computerphobia, each additional computer experience strengthens their negative affective reactions and promotes further computer avoidance" (p. 187). Although most of the studies reviewed lacked generalizability, most researchers who have studied the relationship between computer experience and computer anxiety suggested that computer experience fosters positive attitudes toward the use of computers.

Correlates of Computer Anxiety: Gender

Another area which had been studied extensively is gender. Some studies have found that females were more technophobic than males (Cambre & Cook, 1987; Koohang, 1987; Raub, 1981; Shashaani, 1993), while others have found no gender differences (Dyck & Smither, 1994; Honeyman & White,1987; Loyd & Gressard, 1984a). Rosen, Sears, and Weil examined the relationship between technophobia and gender role, as measured by the Bem Sex Role Inventory. They found that "feminine-identity students had more computer anxiety and more negative computer attitudes than did masculine-identity students, regardless of gender" (1987, p. 178).

Correlates of Computer Anxiety: Age

As with gender, researchers who have studied the relationship between age and computer anxiety have had differing results. Studies in which a wide range of ages were examined tended to report an age effect, with younger subjects less technophobic than older subjects (Cambre & Cook, 1987; Rosen, Sears, & Weil, 1993). In one study, researchers compared a group of 219 college students with a group of 203 senior citizens recruited from senior citizen centers and continuing education courses. They found that the older respondents had less computer anxiety, more positive attitudes, and more liking for computers than did the college students (Dyck & Smither, 1994).

Teachers' Attitudes Toward Computers

Most researchers interested in teachers' attitudes toward computers have used surveys to collect their data. In a few cases, surveys have been combined with naturalistic inquiry methods, such as interviews and classroom observations, and in a few

cases researchers used case study methods, interviewing a few teachers in depth. (Dupagne & Krendl, 1992).

In a survey conducted in 1976, Lichtman reported that educators had a less positive attitude toward computers than did the general public, and that 55% of the teachers surveyed perceived computers as a dehumanizing tool (1979). In more recent surveys of teachers, however, researchers have consistently reported that the vast majority of teachers have a very positive attitude toward computers and are enthusiastic about the value of computers as an educational tool (Aust, Allen, & Bichelmeyer, 1989; Becker, 1986; Davis, 1988; Dupagne & Krendl, 1992; Olson, 1986; Robinson, 1984; Siegel, 1995; Instructor Survey Results, 1991). However, many teachers who held this positive attitude also felt no particular need to master the use of the computer themselves (Hunt & Bohlin, 1993; Stevens, 1980).

Preservice teachers (n=518) at California State University who were enrolled in computing courses reported low anxiety toward computers, confidence in their own abilities, and a general liking for computers. However 25% disagreed with items such as, "It wouldn't bother me at all to take computer classes", and "I would feel at ease in a computer class", and 31% disagreed with the statement, "I will need a firm mastery of computers for my future work" (Hunt & Bohlin, 1993, p. 495).

The belief of teachers that computers are good, but not for me, may have contributed to the failure of a computer program in Utah. In a case study of teachers in a Utah elementary school in which computers were being introduced to the classroom, Callister (1986) found resistant behavior among the teachers and only a moderate degree

of success in implementing the computer program. Although Callister focused on teachers' roles and power, the discussion of the results of the study leave little doubt that computer anxiety played a large part in what amounted to teachers' sabotage of the program. Teachers were afraid that the computer would take their place in the classroom and that they would relinquish their power to the machine. When difficulties arose in the operation of the machines (e.g., frequent malfunctions, programs which did not run properly, difficulty in getting parts and having repairs made), teachers quickly took the opportunity to wash their hands of computers, and quietly formed a line of passive resistance, blaming the failure of the program on the failure of the equipment (Callister, 1986, pp. 191-196).

Becker (1994) identified 45 exemplary computer-using teachers by examining data from a national probability sample survey of 1,400 American schools. The exemplary teachers' goals in using computers and the amount of time they allowed students to use computers differed markedly from goals and levels of use reported by the remainder of the teachers, as did the types of use made of computers. In contrast to the teachers for whom basic skills drill was the most important use of the computer, exemplary teachers focused on writing, problem solving, and inquiry- and discovery-based learning (1994, pp. 318-319).

Summary of Literature Findings

The TLC model. The TLC model, developed and marketed by the IBM Corporation, challenges teachers to integrate technology into the elementary school curriculum. Using IBM equipment and software, teachers are asked to redesign their

classrooms and their method of instructional delivery to include small group instruction in learning centers, in which the teacher actively participates as a facilitator. No formal evaluation studies of TLC were identified. This was because TLC is not a specific program, but rather a model or concept which allows teachers flexibility to design instruction as they see fit, utilizing computers to deliver a significant portion of that instruction. However, studies of the effect on student achievement of two software programs uniformly recommended for use in TLC classrooms do exist.

Writing to Read and Writing to Write. The centerpiece of the TLC concept are IBM's most famous software programs, Writing to Read, and Writing to Write. Early studies of the effect of these programs on student achievement were largely inconclusive. However, several major, longitudinal evaluation studies of schools in which these programs were used for 3-5 years were identified. Although the studies differed in many ways, the results reported by each of the researchers were similar: Students who used Writing to Read and Writing to Write on a regular basis during first and second grades did significantly better on standardized tests and writing samples than students of the same demographic characteristics who were exposed to traditional classroom instruction. Although much more research is necessary to establish the efficacy and long-range benefits of these software programs, it appeared that IBM's commitment to use Writing to Read and Writing to Write as the main software programs to be used in Grades 1 and 2 had a fairly strong basis in research.

The review of the literature on technophobia, or computer anxiety, revealed that there were numerous definitions of this most modern of anxiety manifestations.

However, there was basic agreement among researchers that technophobia is very real, and that it can occur when actually using a computer, or when thinking about using a computer. The definition of technophobia by Rosen and Weil (1992), which appeared to be the most clear and accurate one and represents a summation of all other available definitions, was identified for use in this study.

Correlates to computer anxiety. Research studies which dealt with establishing correlations between computer anxiety and previous experience with computers, gender, and age were examined. Although many studies were significantly flawed, it appeared that there was a negative correlation between computer anxiety and previous experience. The correlations between computer anxiety and gender and computer anxiety and age were less clear. Depending on the context, researchers reported both negative and positive correlations.

Teachers' attitudes toward computers. Numerous surveys have been conducted to elicit attitudinal responses from teachers. For the most part, teachers had a positive attitude toward computers and valued computers as an educational tool. However, several researchers reported that the majority of teachers who took part in these studies felt that computers were good for helping students learn through drill and practice, but they did not necessarily feel that computers were for them, nor did teachers fully utilize computers. Clearly, anxiety about the use of computers in the classroom persists among teachers.

The Need for Continued Research

Given the rush to acquire computers in schools discussed in Chapter I, continued research on computer anxiety in a variety of contexts is needed to provide information to school personnel that may be helpful in implementing computer-assisted instruction. "As computers become more available in the classroom, it is imperative to clarify the reactions that teachers have to the technology" (Rosen & Weil, 1995, p. 13).

The present research was undertaken to clarify the reactions of a specific group of elementary school teachers to the IBM TLC model they had been asked to implement at their school. It builds on and adds to the research literature on computer anxiety and teacher's attitudes toward computers by focusing on the relationship between the teachers' levels of technophobia and their implementation of an elementary school computer-assisted instructional delivery model. The present research was the first of its kind designed to examine the ways in which teachers actually implemented the TLC computer-assisted instructional delivery model and to ascertain whether the way in which teachers implemented TLC was related to their level of technophobia The methods employed in the study are discussed in the following chapter.

CHAPTER III
METHODOLOGY

Introduction

The purpose of this study was to gain knowledge that may be useful in implementing computer-assisted instructional delivery models in elementary schools. The study was designed to explore the relationship between technophobia and teachers' implementation of a specific computer-assisted instructional delivery model, IBM's Teaching and Learning with Computers (TLC).

The study was guided by the following questions:

1. What is the relationship between teachers' scores on the CARS (Form C) and the extent to which they implemented the TLC model?

2. What is the relationship between teachers' scores on the CTS (Form C) and the extent to which they implemented the TLC model?

3. What is the relationship between the GATCS (Form C) and the extent to which they implemented the TLC model?

In order to achieve a contextual understanding of teachers' attitudes towards computers and the process of change being brought about by implementation of the TLC program, both qualitative and quantitative research methodologies were employed, with emphasis on naturalistic methods as the primary investigative tools. Case study methods, including semi-structured interviews, classroom observations, and a review of documents

including semi-structured interviews, classroom observations, and a review of documents were employed. In addition to case study methods, a set of three validated questionnaires (Rosen & Weil, 1992) were utilized in order to determine teachers' level of anxiety toward computers. The questionnaire results formed an embedded quantitative element within the case study, augmenting and strengthening the qualitative findings.

The rationale for the choice of research methodologies, as well as descriptions of the population to be studied, the specific methods to be employed, and the proposed methods used to collect and analyze the data are discussed in detail in the sections that follow.

The Qualitative Perspective

The qualitative research perspective was adopted as the primary means of collecting data to answer the research questions posed on the preceding page. Although qualitative methods are often associated with words such as ethnographic, field work, life history, descriptive, and naturalistic (Bogdan & Biklin, 1982), and conjure up visions of pith-helmeted anthropologists moving in with remote native tribes to study their culture, research of the sort made famous by Margaret Mead bears little outward resemblance to modern, qualitative studies in the educational arena. There are, however, common threads which connect field anthropology and studies conducted in school settings. Both types of research are grounded in symbolic interactionism, involving inquiry into the characteristics of social phenomenon and detailed description of such phenomena (Lofland, 1971). Both types of research result in the type of "thick description" which paints a detailed portrait of the phenomena being studied (Guba & Lincoln, 1982), and

both aim to understand human experience "as nearly as possible as its participants feel it or live it" (Sherman, Webb, & Andrews, 1984, p. 27). Qualitative researchers value that which is non-observable, such as the attitudes, concerns, and perspectives of people, including their subjective interpretations and reactions to situations and experiences, in the realization that it is those very subjective interpretations and reactions which mediate people's behavior (Guba & Lincoln, 1982, Rist, 1977).

The primary research tool used in this study was the case study. The case study, as defined by Stake (1994) is not a choice of method, but rather a choice of object to be studied. In this case, the object to be studied was a group of 13 teachers at a school which, for purposes of this study, will be called Pioneer Elementary School, where the IBM TLC model was being piloted.

Stake further stated that the choice of a case as the object of study is guided largely by the researcher's purpose. The present study represents what Stake would call an "instrumental case study," in that the purpose in choosing this particular case was to "provide insight into an issue . . . The case is of secondary interest; it plays a supportive role, facilitating our understanding of something else. . . . The choice of case is made because it is expected to advance our understanding of that other interest" (1994, p. 237). The "other interest" in this case was to determine whether the TLC model was being properly and fully implemented.

During the 1994-95 school year, the Duval County School Board invested almost a quarter of a million dollars to retrofit Pioneer Elementary School, install a Local Area Network (LAN), equip every classroom with IBM computers and software, and provide

teachers with training in IBM's Teaching and Learning with Computers (TLC) program. Having made the investment, decision makers at the district level needed information about the efficacy of the TLC training and the degree to which teachers were actually utilizing the new equipment and their TLC training to integrate computers into instruction. This information would guide later, longitudinal studies which would focus on the effect of TLC on student achievement, and would also inform future decisions about the purchase of equipment and training for other schools.

Because Pioneer Elementary School was the only school in the area in which the entire classroom teaching staff was participating in a model which integrated computers into classroom instruction, it was a case which warranted careful, detailed study in order to guide decision making and to determine the course of further study.

"The distinctive need for case studies," according to Yin, "arises out of the desire to understand complex social phenomena," and ". . . allows an investigation to retain the holistic and meaningful characteristics of real-life events." (1989, p. 14) The case of Pioneer Elementary School was one in which the dynamic and complex variables which comprised teachers' attitudes toward computers and their willingness to change their style of instructional delivery to include the use of computers and learning centers, as advocated by the developers of IBM's TLC model, was studied in a real-life context. The study took place during a period of time in which computer equipment had just been installed in the classrooms of nine Phase I teachers, the nine teachers had received 60 hours of TLC training, and expectations for implementation of TLC on the part of the school's principal and district level administrators was high. With the understanding that

change of almost any type is difficult and that change occurs in stages (Rogers, 1965), the researcher probed both the differences and the commonalties in attitude and action evidenced by the teachers.

Setting of the Study

Data collection took place at Pioneer Elementary School in Jacksonville, Florida, during the period between May 8 and May 26, 1995. At the time of the study, the researcher was employed by the Duval County School Board and was invited to design and conduct the qualitative portion of the district's preliminary evaluation. All interviews, observations, and the review of documents described in the sections which follow were conducted by the researcher while still a Duval County employee. The data are therefore the property of the Duval County School Board and were analyzed for purposes of this dissertation with permission of the Director of Research and Evaluation, Dr. William Fryar.

Participants

Thirteen teachers on the school's staff were included in the study, including 11 classroom teachers in grades K-5 and two Exceptional Student Education (ESE) teachers. The school's media specialist and principal were also interviewed, and supplementary data provided by them were included in the results of study. Because the school had no male teachers at the time of the study, all participants were women.

The participants were divided into three distinct groups, referred to throughout the study as Phase I teachers, Phase II teachers, and Phase III teachers. Phase I teachers included nine K-3 classroom teachers who, at the time of the study, already had

computers installed and operational in their classrooms, had received instructional materials to complement the network software, and had participated in the full 60 hours of training recommended by IBM representatives. Phase I teachers, who were the only teachers ready to implement the TLC model, were the main focus of the study.

Phase II teachers included four classroom teachers in grades four and five and one grade two teacher who joined the staff after the 1994-95 school year had begun. At the time of the study, most of these teachers had received computers, but not all computers were fully operational or networked, nor had instructional materials been received by every teacher. In addition, Phase II teachers had only received a few days of TLC training and were not yet ready to fully implement the model. Phase III teachers, including all four Exceptional Student Education teachers and one teacher assigned to students in Project GROW, had received neither computers, nor materials, nor training at the time of the study. Because Phase II and Phase III teachers were not ready to implement the TLC program at the time of the study, interview and questionnaire data from only two, randomly selected teachers in each group were included in the study.

Research Design

The research design employed in this study was that of the single-case study in which the unit of analysis (Merriam, 1988) was the participating teachers at Pioneer Elementary School. The design utilized both qualitative methodologies--including interviews, observations, and a review of documents--and quantitative methods, including three technophobia questionnaires (Rosen & Weil, 1992).

The case study strategy was selected for three reasons, suggested by Yin (1989). The first was the type of research question posed. The questions posed in this study dealt with the relationship between technophobia and its effect on teachers' implementation of the IBM TLC program at Pioneer Elementary School. Although it is often possible to answer attitudinal (*e.g.*, how and why) questions by means of a survey, Stake pointed out that "Previously unknown relationships and variables can be expected to emerge from case studies, leading to a rethinking of the phenomenon being studied. Insights into how things get to be the way they are can be expected to result from case studies" (1981, p. 47).

A second consideration suggested by Yin (1989) is the extent of control the researcher has over actual behavioral events; and a third consideration is the degree of focus on contemporary as opposed to historical events. In this case, the researcher had no control over the behavioral events surrounding implementation of the TLC program, and was, rather, an observer of contemporary history in the making. Yin (1989), however, differentiated between a history and a case study:

> The case study is preferred in examining contemporary events, but when the relevant behaviors cannot be manipulated. Thus, the case study relies on many of the same techniques as a history, but it adds two sources of evidence not usually included in the historian's repertoire: direct observation and systematic interviewing. (p. 19 ff.)

Several sources of information were included, so that data could be triangulated (Mathison, 1988; Popham, 1988). These sources included semi-structured interviews, formal and informal observation, review of documents, and results of the Rosen and Weil (1992) technophobia questionnaires.

Questionnaires

In order to determine whether the participating teachers were in any way technophobic or anxious about using computers, they were asked to complete a three-page questionnaire developed by Rosen and Weil (1992), each page of which was designed as a separate instrument. The questionnaires included the Computer Anxiety Rating Scale (Form C) (CARS-C); the Computer Thoughts Survey (Form C) (CTS-C); and the General Attitudes Toward Computers Scale (Form C) (GATCS-C). (Copies of the three questionnaires are included in Appendix A, pp. 105-108.)

Rosen and Weil contended that technophobia is "composed of three separate but overlapping dimensions, including anxiety, negative cognitions, and negative attitudes" (Rosen & Weil, 1992, pp. 8-9). Rather than try to capture all three dimensions in one instrument, the authors developed three separate measures, each designed to examine a single dimension of technophobia in depth. The instruments were created to distinguish individuals who are technophobic from those who are not technophobic. The CARS is positively skewed, the CTS is negatively skewed, and the GATCS is leptokurtic. On each measure, a higher percentile rank indicates a person with more technophobia.

The Computer Anxiety Rating Scale (CARS-C) contains 20 items that measure technological anxiety by referring to experiences or things which are possible sources of apprehension (*e.g.*, applying for a job that requires computer training, getting an error message from a computer, or erasing or deleting a computer file). Respondents are asked to check the box which best describes how nervous, or anxious, they would feel if this

were to happen to them *at that point in their lives*, using a five-point scale, from "Not at All" to "Very Much".

The Computer Thoughts Survey (CTS-C) contains 20 items to measure specific thoughts and cognitions that people have when working with technology or when contemplating working with technology. Items are rated using the same five-point scale as the CARS-C. Respondents are asked to check the box which best describes how often they have thoughts such as "This will be fun" or "What if I hit the wrong button?" when they use a computer or think about using a computer.

The third questionnaire, the General Attitudes Toward Computers Scale (GATCS-C), contains 20 items which addressed general attitudes toward computers. Respondents are asked to check the box which best describes their level of agreement with statements such as, "Computers prepare students for the future" and "Computers will never be smarter than people." Items are rated on a five-point scale which ranges from "Strongly Agree" to "Strongly Disagree."

Reliability of the Instruments

The technophobia measurement instruments described above have been used extensively, and have undergone substantial revision since the original edition (Form A) appeared in 1985. In their present form (Form C), two of the instruments (the CARS-C and the CTS-C) are considered quite reliable, each having Cronbach's alpha coefficients above .80 for all items. The third instrument (GATCS-C) is less stable, with reasonable, but not strong, reliabilities ranging from .36 to .75, with a median of .59. Two items in particular ("You need to know how to use a computer to get a good job" and "In five

years, everyone will need to know how to operate a computer") have proven to be problematic, and the authors recommend that these items be examined separately and removed if they reduce the reliability of the GATCS-C. Overall, the GATCS (Form C) is reasonably reliable, but not as reliable as the CARS (Form C) or the CTS (Form C).

The questionnaires were designed to be self-administering, and were mailed to each participating teacher at the school in early May, 1995. Participants were advised that the questionnaires should take no longer than 20 minutes and were asked to complete the forms on their own (without conferring with colleagues) and to return them to the researcher immediately in a return envelope which was supplied.

The questionnaires were scored by the researcher using directions given in the instrumentation manual (Rosen & Weil, 1992). The problematic items in the GATCS-C, discussed above, were considered separately and were incorporated into interview results, in which similar questions were asked.

Semi-structured Interviews

Long interviews (McCracken, 1988) were held with each of the participating classroom teachers, as well as the media specialist and the principal, between May 8 and May 26, 1995. The interviews were semi-structured; that is, the same questions were asked of each informant. The interview questions appear in Appendix B, p. 109. The questions were based on (a) ideas suggested by the teachers themselves during informal, preliminary talks, (b) the review of the literature, and (c) specific requests for information from the district's Deputy Superintendent for Instruction and Curriculum and the Director of Research and Evaluation. However, the researcher asked additional

questions as the situation warranted, and allowed time for additional comments from each participant. As Merriam observed,

> In the semi-semi-structured interview, certain information is desired from all the respondents. These interviews are guided by a list of the questions or issues to be explored, but neither the exact wording nor the order of the questions is determined ahead of time. This format allows the researcher to respond to the situation at hand, to the emerging world view of the respondent, and to new ideas on the topic. (1988, p.74)

Interview techniques suggested by McCracken (1988) and Spradley (1979) were used. Preliminary biographical information on each participant was gathered prior to the interview by means of a brief information form developed by the research. This Preliminary Questions form appears in Appendix C, p. 111. Participants were asked to state their age, the highest college degree held, their years of teaching experience, and the number of years they had been teaching at Pioneer Elementary School. In addition, participants were asked to list any computer training they had prior to TLC. Letter names *(e.g.*, Teacher A, Teacher B) were used throughout the study to assure participants' anonymity and increase their level of comfort with the research process.

Time was also allowed for informal, unstructured discussion because, as Harry F. Wolcott observed, "Ranging as it does from casual conversation to direct questioning, informal interviewing usually proves more important than semi-structured interviewing in an extended study" (1988, p. 196). Thus, information collected from such discussions, which occurred before or after meetings, in hallways or parking lots, in the teacher's lounge, or during lunch were either tape recorded and later transcribed or immediately word processed, depending on the circumstances and availability of equipment.

Structured interviews were held at times and places convenient to the participants, and took place between May 8 and May 26, 1995 (Appendix D, p. 113). With permission from each participant, interviews were tape recorded. Researcher observations and comments were also taped immediately before and after each interview, and all data were transcribed verbatim as quickly as possible after the interview by the researcher, with assistance from secretarial staff in the Departments of Research and Evaluation; Planning and Development; and Facilities, Duval County School Board.

Verbatim data from interviews and informal discussions were entered into a computer word processing program. The use of the computer as a data analysis tool enabled the researcher to move around and organize text according to emerging categorical schemes and to copy and print text segments with the same identifying codes for further analysis. The program also had the ability to count frequencies of particular words or codes, and obviated the need for organizing tools such as index cards, folders, scissors, etc. The computer program proved to be a powerful tool in retrieving and displaying occurrences of a category, however,

> . . . it can neither define the category itself nor assess its continuing usefulness. . . . Because data are represented as text, the computer is aware only of their text properties. It is not aware of their properties as objects, categories, concepts, or ideas and it is unable to use those properties to make logical deductions, generalize to other settings, or to perform any of the other tasks which are so important for the interpretation of qualitative data. (Brent, 1984, p. 40)

The definition of categories remained the responsibility of the researcher, and the techniques for definition and analysis of the data are discussed in the section entitled Data Analysis, beginning on p. 50.

Observation

A second source of data consisted of information gathered by means of formal classroom observations conducted by the researcher, as well as informal observations made during the study period. Informal observations consisted of tape recorded or hand written notes made immediately after casual conversations with the participants, or during meetings with groups of participants (*e.g.*, a faculty meeting). These were transcribed to computer files as soon as possible, but no later than 48 hours after the event, and were treated along with the interview data. Formal observation data consisted of information collected during three to four formal classroom observations per teacher. During these classroom observations, each of which lasted approximately 45-55 minutes, the researcher recorded details of the physical arrangement of the room, the action taking place as instruction proceeded, and the interaction of the teachers with their students. The purpose of each observation was to ascertain the extent to which the teachers were actually utilizing the computers and instructional materials supplied to them, determine whether the teachers were employing learning centers during instruction, observe whether teachers moved about the room acting as facilitators of instruction, and to compare teachers' style of implementation with the description of the typical TLC classroom given in IBM training materials.

Review of Documents

The final strategy employed was a review of documents. The list of documents to be examined included

- Florida School Reports for Pioneer Elementary School (1992-95),

- The 1994-95 School Improvement Plan for Pioneer Elementary School,
- 1994-95 School Climate Survey results,
- TLC training materials and teacher manuals,
- Chapter 1 (now Title I) Schoolwide Improvement grant application, 1994,
- Representative computer printouts for each class, detailing time logged, and activities attempted and mastered by students, and
- Problem records kept by the media specialist.

A Document Summary Form was attached to each document collected (Appendix E, p. 115) on which the researcher recorded the name of the document, the event or contact with which the document was associated, the significance or importance of the document, and a brief summary of its contents. Document summaries were coded and their content analyzed (Carley, 1990; Miles & Huberman, 1994; Weber, 1990).

Data Analysis

One of the most challenging aspects of qualitative research is the analysis of data. As Miles and Huberman pointed out, "As soon as the field researcher begins to compile information, challenges appear. A big one is the multiplicity of data sources and forms. . . this information piles up geometrically" (1994, p.55). In order to avoid data overload, the researcher formulated a conceptual framework for the study, which appears in the previous sections. The conceptual framework, in which the research questions were narrowed to focus on classroom teachers' attitudes toward computers and TLC training and the ways in which those attitudes were reflected and demonstrated in actual

instructional delivery, provided the means for selective data collection, in which only data which bore directly on the research questions were collected and analyzed.

Data which bore on the research questions were extracted from the thick text of verbatim transcripts, documents, and observation data through careful use of codes and coding (Miles & Huberman, 1994). Using the research questions and the interview questions as a basis, the researcher developed a provisional start list of five- to six-digit descriptive codes which were applied to "chunks" of data of varying size--words, phrases, or whole paragraphs (Appendix F, p. 117). The list of codes grew as data analysis proceeded and the need for more (or less) detailed codes became more apparent. The researcher read and re-read through the textual data, adding codes in the left margins and personal comments and reflections in the right margins. To increase the reliability and internal consistency of the coding, a research associate from the Department of Research and Evaluation, Duval County School Board, was asked to check-code several of the same data sets and discuss the results with the researcher. Working together, both intra- and intercoder agreement was eventually established at no lower than 90% (Miles & Huberman, 1994). Once the data were coded, the codes were searched, retrieved, copied, and pasted together for further analysis.

After a working set of descriptive codes had been applied to the data and the data had been rearranged by codes, a second level of more explanatory data analysis, called pattern coding (Miles & Huberman, 1994) began. As patterns or themes begin to emerge from the data, they were labeled with pattern codes, which were more inferential and explanatory in nature, and which often began as hunches. These codes emerged

progressively as data were coded and changed and developed as data were analyzed. Some codes did not work, others decayed and had to be discarded. Other codes worked too well, resulting in data which wee too bulky to handle and which then had to be further subdivided and recoded.

As analysis of the data proceeded, memos were written (Glaser, 1978; Miles & Huberman, 1994) as a means of summarizing and tying together data which comprised general concepts. In addition, wall charts (called 'monster dogs' by Miles and Huberman, 1994) were created in an effort to visually display pertinent data in matrix form.

Drawing Conclusions from the Data

The distillation of literally hundreds of pages of textual information into patterns of meaning from which inferences may be drawn is a perilous procedure, fraught with threats to the reliability and validity of the research. Citing extensive research on how people process information, attribute causality, and make erroneous human judgments, "the general finding, baldly put, is that most people are rotten scientists, relying on preexisting beliefs and making bias-ridden judgments. They find patterns in random data, look at incomplete data, see what they want to see, and over-rely on others' judgments, real or assumed" (Miles & Huberman, 1994, p. 262). Several methods were used in this study to combat human fallacy and produce valid and reliable conclusions based on data. The first, described in previous sections, was to adhere to the conceptual framework and proposed research methods so as to avoid data overload and loss of perspective. In addition, Miles and Huberman suggested 13 ways in which data quality

could be assessed (1994, pp. 262-280). These methods were used by the researcher throughout the data collection, analysis, and reporting process. They are outlined here to demonstrate the threats to reliability and validity which must be faced in a qualitative study.

1. Checking for Representativeness

The teachers at Pioneer Elementary School were divided into three groups, which for the purposes of this study were called Phase I teachers , Phase II teachers, and Phase III teachers. Based on the perceived long-range needs of the students, the school's principal, with input from the staff, decided at the outset of the project to train teachers of grades K-3 first and to equip their classrooms first. These teachers began their training during the summer of 1994, and their classrooms, with a few exceptions, were retrofitted, fully equipped and ready for use by students at or near the beginning of the 1994-95 school year. This first group of teachers was called Phase I teachers. Because these were the teachers who had the most training and who were already implementing the TLC model in their classrooms, all Phase I teachers (n=9) were included in this study.

Phase II teachers included one second grade teacher who was added to the staff after the beginning of the 1994-95 school year, and all fourth and fifth grade teachers (n=5). This group began their training well after the beginning of the 1994-95 school year and received their equipment and materials later in the school year, some as early as January 1995, some not until March 1995. Of these five teachers, two were randomly selected to participate in this study.

Phase III teachers (n=5) include four Exceptional Student Education (ESE) teachers and one teacher assigned to students in Project GROW, an intervention program for students with behavioral and/or attitudinal problems. These teachers had received little TLC training, and at the end of the 1994-95 school year had not yet received their equipment or materials. Of these five teachers, two were randomly selected for inclusion in this study, for a total of 13 classroom teachers. In addition, the school's media specialist and the principal were interviewed, and data collected from them was used as supplemental information.

Because all Phase I teachers are included, and because teachers in Phases II and III were randomly selected, the researcher avoided over reliance on accessible and elite informants, which results from sampling nonrepresentative informants or studying only those who volunteer for the study.

The researcher was at the study site continuously for three weeks while school is in session, moving in and out of classrooms, having lunch in the teachers' lounge, lingering in hallways before and after classes, chatting with students, attending all school events, and generally becoming part of the school family. Continuous presence during the study prevented generalizing from nonrepresentative events or activities.

2. Checking for Researcher Effects

There can be little doubt that the teachers at Pioneer were extremely aware of the research being done around them, both by the researcher and by members of the school district staff. Most took it - at least outwardly - in stride, some expressed nervousness and apprehension at being the subject of research, a few were visibly unhappy about the

prospect of being closely observed, and one was candid enough to admit that if she had known there was going to be so much scrutiny of the TLC model and so many strangers in her classroom distracting the children, she would not have wanted it.

Obviously, when the Superintendent of Schools entered TLC classrooms, accompanied by executives from IBM and several assistant superintendents, teachers had every right to be nervous. The result in such a situation is likely to be that situations or behaviors are exhibited that would not ordinarily have occurred. However, the researcher was continuously on site for three weeks and in every classroom almost daily. This period of time was assumed to be sufficient to allow the teachers and students to become used to the researcher's presence and to begin to ignore it, enabling the researcher to become "part of the local landscape" (Miles & Huberman, 1994, p. 265).

The researcher kept a low profile and made every effort to be unequivocal with the teachers, telling them exactly why the research was being done, what was being studied, how information was to be collected, and what would be done with it. Field notes were shown to a colleague, following a suggestion by Miles & Huberman, in that "another researcher is often much quicker to see where and how you are being misled or co-opted" (1994, p. 266). Nonetheless, it is important to keep in mind that research of this sort continued to be considered threatening to some teachers.

> For some analysts (Douglas, 1976), local informants' interests are fundamentally in conflict with those of the researcher, who might penetrate to the core of the rivalries, compromises, weaknesses, or contradictions that make up much of the basic history of the site. Insiders do not want outsiders - and sometimes other insiders -to know about such things. So the researcher, who is usually interested in uncovering precisely this type of information, must assume that people will try to be misleading and must shift into a more investigative mode. Field research can, at bottom, be considered as an act of betrayal, no matter how well

> intentioned or well integrated the researcher. You make the private public and leave the locals to take the consequences. (Miles & Huberman, 1994, p. 265)

In order to avoid being misled, the researcher triangulated several data collection methods, so that conclusions did not overly depend on any one type of data to make sense of the setting. The fact that the researcher had 12 years of experience as an elementary school classroom teacher and was familiar with the schedules, routines, and daily challenges present in the classroom also helped to ensure that data were not confounded.

3. Triangulating

Data collected from different sources (*e.g.,* interviews, observations, classroom diagrams, examination of documents, and questionnaires) may be consistent and converge, or they may be inconsistent and conflict. The use of a data matrix (described in a preceding section) to display and triangulate findings and aid in making comparisons and contrasts helped to establish not only reliability but validity as well (Mathison, 1988).

4. Weighting the Evidence

Certain data may be stronger than others, raising the question of validity (Kirk & Miller, 1986). One informant may be more articulate or reflective than another, or may simply have more knowledge of or experience with the subject at hand. Data may also be stronger because of the researcher's efforts to establish validity, discussed in the previous three sections, or because the researcher is realistic enough to look for ulterior motives and deception by the informants.

> Douglas (1976) emphasizes that regardless of the degree of trust a field-worker may believe has developed, people in field sites nearly always have some reasons for omitting, selecting, or distorting data, and also may have reasons for deceiving the field-worker (not to mention deceiving themselves). If you have entertained

> such a view of certain respondents, and of the data from them, and have done something to validate the data, more confidence is justified. (Miles & Huberman, 1994, p. 268)

The researcher utilized validating techniques suggested by Douglas (1976), including checking against hard facts and alternative accounts; sharing personal material to open up the respondent; asserting knowledge of the situation and asking the respondent to confirm or deny it; and naming possible ulterior motives (e.g., wanting to protect self or colleagues, personal preference for traditional teaching modes) to see what the response was.

5. Checking the Meaning of Outliers, and 6. Using Extreme Cases

In any given study, especially one which focuses on attitudes, opinions, and behaviors, there are almost bound to be cases in which the respondents express positions which are diametrically opposed to most of the others. Miles and Huberman's advice was to treat these cases as 'your friends' (1994, p. 269), as the data they provide may paint a deeper, more intricate picture of the case. Through preliminary discussions with key informants at the school, the researcher identified several teachers who were known to be noticeably less enthusiastic about TLC than the others. The data collected from these teachers were examined with particular care. Persons known to have a strong bias, if present, may contribute significant data of yet another sort. For instance, if a teacher who genuinely and enthusiastically supports every aspect of TLC reports strong negative experiences in a single aspect of the program, the negative data would assume more weight in the analysis.

7. Following up Surprises

As data collection proceeded and analysis began, preliminary conclusions began to suggest themselves. Whenever the researcher was surprised by responses or behaviors which violate the preliminary conclusion, the researcher reflected, considered, and revised, searching for evidence to confirm the revision.

8. Looking for Negative Evidence

A tactic related to but perhaps more extreme than looking for outliers or extreme cases, is that of looking for negative evidence (Glaser & Strauss, 1967), in which the researcher actively seeks disconfirmation of preliminary conclusions. The researcher identified a skeptical colleague to review the data for evidence that would disconfirm the preliminary conclusion, and used the evidence to formulate an alternative conclusion that dealt with the evidence.

9. Making If-Then Tests

If-Then statements were used to represent the formative stage of linking variables, beginning to ascertain relationships among them, and formalizing propositions and predictions. More focused and specific than a working hypothesis which supports the general analytic direction, If-Then statements were used as a necessary next step in forming a theory as to what is actually happening (Miles & Huberman, 1994).

10. Ruling Out Spurious Relations

Before reaching conclusions about how variables might be related, the researcher searched for rival explanations and intervening variables and invited friendly skeptics to dismantle relationships by doing likewise. As in statistical analysis, it was necessary to consider whether some third variable might offer a possible explanation.

11. Replicating a Finding

Validity is enhanced when findings are confirmed by more than one way of measuring the same thing (Mathison, 1988). But Miles and Huberman warned against the 'holistic fallacy':

> Still the fact that usually one person is doing all of this measuring with homemade instruments is grounds for precaution. Once you've latched onto a hypothesis that makes powerful sense of the case, it's the dickens to get rid of it. Confirmation seems, almost magically, to come from all quarters. New interviews, observations, and documents all appear to bring verification, and to fit together coherently. This is a heady and very dangerous time, and it usually means that you are knee-deep in the "holistic fallacy":..putting more logic, coherence, and meaning into events than the inherent sloppiness of social life warrants. (1994, 273)

The authors suggested thinking in terms of replication, testing whether a newly collected finding can be reproduced in another part of the case or data set, tracking to see if the pattern is repeated.

12. Checking Out Rival Explanations

Rival explanations may be forced upon the researcher by the data, in which case they must be carefully examined. Again, a skeptical colleague was consulted to help point out discrepant data and suggest alternative explanations.

13. Getting Feedback From Informants

Findings in summary form were shared with the teacher/participants, and their input was solicited before the final results were published.

A linear-analytic structure was used for the final chapters (Yin, 1989), a standard approach was used to summarize the findings from the data analysis, and the conclusions and implications from the findings. The focus of the chapters represents a thesis (Bogdan

& Biklen, 1982), in this case a comparison of observed behaviors with attitudes expressed in the semi-structured interview and the level of technophobia detected by the questionnaires. Letter names assigned to each teacher were used throughout the final chapters when direct quotes were used, but for the most part aggregate evidence predominated. In addition, the actual name of the school was changed to "Pioneer Elementary School." The draft was reviewed by colleagues at the Duval County School Board who were familiar with the case, as well as by the participants and representatives from IBM who have been involved with the project. This procedure was used not just as a professional courtesy, but "as a way of corroborating the essential facts and evidence presented in the case report" (Yin, 1989, p. 144) and thus increasing the construct validity. Exceptionally helpful comments were incorporated into the case (Schatzman & Strauss, 1973).

CHAPTER IV
RESULTS

The Study Locale

The study was conducted in Duval County, located on Florida's northeast coast, and encompassing the City of Jacksonville. Jacksonville/Duval County is the 15th largest school district in the country, with over 123,000 students enrolled in 149 schools during the 1994-95 school year. The racial/ ethnic distribution among the district's students, as of February 10, 1995, was 55.9% White; 39.2% African-American; 2.6% Hispanic; .5% American Indian; and 2.4% Asian (Duval County School Board, 1995). Pioneer Elementary School, located in a suburban section of Jacksonville, had 423 students enrolled during the 1994-95 school year, of which 32.9% were White; 63.8% were African-American; 1.9% Hispanic; 1.9% Asian; and .5% were American Indian (Florida Department of Education, 1994).

For decades, the neighborhood surrounding Pioneer Elementary School had remained a mostly residential section of Jacksonville. Its busy main traffic arteries were lined with businesses of all kinds, and modest concrete-block, single-family homes and low income apartment complexes and public housing projects predominated along the streets which ran behind the main arteries. Pioneer Elementary School was located on a quiet street off one of the area's main thoroughfares.

At the time of this study, the Pioneer Elementary School area was a community in transition. Historically a middle class white neighborhood, homes and apartments had gradually been rented to African-Americans and other minorities. This trend had dramatically impacted the school, which had an extremely high rate of student mobility (66.3%), as well as a steadily increasing number of African-American, Hispanic, and Asian students (Florida Department of Education, 1993, 1994, 1995).

The school was a one-story structure of yellow brick, laid out in the shape of a long three-legged table. The cafeteria, administrative offices, and the school library were located along one very long hallway, which might be imagined as the top of the table. Three shorter, parallel hallways ran perpendicular to the main hallway, and can be imagined as the three legs of the table.

Each of the three hallways had classrooms on either side, and the three hallways were segregated by grade level. During the 1994-95 school year, Hallway 1 contained Pre-K, Kindergarten and first grade classrooms, as well as the school's Title 1 Computer Lab. Hallway 2, the center hallway, housed the second grade and third grade classrooms, while Hallway 3 was the location of grade four and grade five classrooms, as well as several rooms allocated to Exceptional Student Education. The architectural layout of the school in three separate hallways tended to isolate grade levels from each other while allowing teachers from the same grade level to communicate with one another more regularly.

At the time of the study, Pioneer Elementary School was the only school in the Duval County School System in which the IBM Teaching and Learning with Computers

(TLC) model was being implemented schoolwide, primarily with district funding, on an experimental basis.

Participants

Thirteen teachers on the school's staff took part in the study, including 11 classroom teachers in grades K-5 and two Exceptional Student Education (ESE) teachers. The school's media specialist and principal were also interviewed, and supplementary and background data provided by them were included in this chapter. Because the school had no male teachers at the time of the study, all participants were female.

The participants were divided into three groups, referred to throughout the study as Phase I teachers, Phase II teachers, and Phase III teachers. Phase I teachers included nine K-3 classroom teachers who, at the time of the study, already had IBM computers and printers installed, networked, and operational in their classrooms, had received instructional materials to complement the network software, and had participated in the full 60 hours of training recommended and provided by IBM representatives. Phase I teachers, who were the only teachers fully equipped and trained to implement the TLC model, were thus the main focus of the study.

Phase II teachers included classroom teachers in grades four and five and one second grade teacher who had joined the staff after the 1994-95 school year and the IBM training had begun. At the time of the study, the Phase II teachers had received some of the computers and equipment which had been ordered for them, but not all computers were fully networked and operational, nor had instructional materials been received by every teacher. In addition, Phase II teachers had only received a few days of TLC

training, and were not yet fully ready to implement the TLC model. Phase III teachers, including four Exceptional Student Education (ESE) teachers and one teacher assigned to students in Project GROW, had received neither computers, nor materials, nor training at the time of the study. Because Phase II and Phase III teachers were not yet fully equipped or trained to implement the TLC model at the time of the study, interview and questionnaire data from only two randomly selected teachers in each group were included in the study.

A Profile of Participating Teachers

Before each interview, the teachers who participated in the study were asked to fill out a Preliminary Questions form (Appendix C, p. 111). This form requested the teacher's name, age, highest college degree, the number of years of teaching experience (including the year in which this study took place), and the number of years experience at Pioneer Elementary School. In addition, the form asked teachers to list any computer training they had received prior to the TLC training.

Data collected from the nine Phase I teachers by means of the Preliminary Questions form were used to construct a profile of the Phase I teachers as a group. These data revealed that the nine Phase I teachers ranged in age from 25 to about 55, with an average age of approximately 40.9. (The figure is approximate because one of the older teachers declined to give her exact age and would only say that she was "50 plus." Her age was approximated at 55.) Among the nine Phase I teachers, three (33.3%) held master's degrees, and six (66.6%) held bachelor's degrees. Their years of experience as teachers ranged from two to 27 years, with an average of 12.4 years of teaching

experience, and their years of teaching at Pioneer Elementary School ranged from 2 to 20 years, with an average of 8.2 years. Over half of the nine teachers in Phase 1 had spent more than half of their teaching careers at Pioneer Elementary School.

Among the randomly selected Phase II and Phase III teachers (n=4), the average age was slightly higher, or 45.3 years old. (As with Phase I teachers, one teacher declined to give her exact age, and listed herself as "50 plus." Her age was also approximated at 55 for purposes of this equation.) Two of the Phase II and Phase III teachers held master's degrees; two held bachelor's degrees. Their years of teaching experience ranged from 13 to 35 years, with an average of 21.7 years of teaching experience, and their years of teaching at Pioneer Elementary School ranged from 2 to 17 years, with an average of 7.2 years.

As with any group of teachers, the participants in this study represented a range of age levels, experience, and educational backgrounds. The Phase I teachers were, on average, slightly younger and somewhat less experienced as a group than the Phase II and Phase III teachers, and more likely to hold a Bachelor's degree. However, on average, teachers at Pioneer Elementary School had 7-8 years experience at that school, indicating a tendency toward staff stability. The stability of the faculty was further corroborated by the 1993-94 Florida School Report, which confirmed that only three of the school's 1992-93 instructional and other professional staff of 18 did not return for the 1993-94 school year, a staff turnover rate of 16.7%, equal to the state staff turnover rate, and only slightly higher than the district rate of 14.1%. The relative stability of the staff was, for the

principal, one of the primary selling points for Pioneer Elementary School as the location in which to pilot the TLC model:

> One of the things I sold [the Deputy Superintendent for Instruction and Curriculum] on is the fact that the faculty is pretty stable, so you don't have the teacher turnover. If you have a huge turnover, then your training goes down the drain, whereas here people tend to stay, so once you've trained them, they're here. And they're going to build on that every year.

Results of the Technophobia Questionnaires

Each of the 13 teachers who participated in the study was asked to fill out the three-page questionnaire instrument developed by Rosen and Weil (1992). These included the Computer Anxiety Rating Scale (CARS) (Form C), the Computer Thoughts Survey (CTS) (Form C), and the General Attitudes Toward Computers Scale (GATCS) (Form C). Eleven completed questionnaires were returned, for a response rate of 84.6%. Questionnaire scores appear on the following page.

Despite repeated requests to do so, two Phase I teachers did not return the questionnaire forms, although they did agree to cooperate with all other the other research requests made of them, including structured interviews and multiple observations in the classroom. Miles and Huberman (1994) suggested that in such cases, negative behavior should be treated as a challenge, because the data provided by such subjects often paints a deeper, more intricate picture of the case. In order to compensate for the missing questionnaires, the researcher therefore scheduled an additional observation visit to the classrooms of each of these teachers, posed additional questions relating to technophobia during their interviews, and generally took more care to observe these teachers.

TEACHERS' SCORES ON THE TECHNOPHOBIA QUESTIONNAIRES
(ROSEN & WEIL, 1992, FORM C)

COMPUTER THOUGHTS SURVEY (CTS)
GENERAL ATTITUDES TOWARD COMPUTERS SURVEY (GATCS)
COMPUTER ANXIETY RATING SCALE (CARS)

Teacher	Phase	CTS Score	GATCS Score	CARS Score	Technophobia Level	Classroom Arrangement
A	1	69	66	45	Low	Transitional
B	1	87	77	34	None	TLC-Oriented
C	1	79	61	70	Moderate/High	TLC-Oriented
D	1	NR	NR	NR	NR	TLC-Oriented
E	1	100	77	23	None	TLC-Oriented
F	1	74	75	49	Low	Transitional
G	1	NR	NR	NR	NR	Traditional
H	1	73	80	41	None	TLC-Oriented
J	1	86	65	24	None/Low	Transitional
W	3	79	78	30	None	NA
X	3	80	75	33	None	NA
Y	2	59	67	34	Moderate/High	NA
Z	2	74	70	32	None/Low	NA

NR = Not Returned
NA = Not Applicable

TABLE 4-1

The following paragraphs provide a discussion of the aggregate results of the questionnaires. Individual results will be discussed in later sections, as will data from the two teachers who did not return questionnaires.

Results of the General Attitudes Toward Computers Scale (GATCS)

The GATCS is scored in such a way that higher scores indicate more positive attitudes toward computers. Respondents who score between 64 and 100 on this scale are said to have "No Technophobia"; a score of 56-63 indicates "Low Technophobia"; and a score between 20 and 55 indicates "Moderate/High Technophobia" (Rosen & Weil, 1992, p. 30). The 11 teachers who returned the GATCS (Form C) questionnaires had scores which ranged from a low of 61 (Low Technophobia) to a high score of 80 (No Technophobia). Interestingly, the range of scores was much wider among the seven Phase I teachers (from 61 to 80) than among the four Phase II and III teachers, whose scores ranged from 67 to 78. On average, Phase II and III teachers had slightly higher scores than their colleagues in Phase I (average of 72.5 compared to a Phase I average of 71.6). Examination of subscales within the questionnaire showed little variation, except in one subscale, Attitudes Toward Computers in Education. Within this subscale, the three teachers who scored lowest on the overall scale had lower scores than those of other teachers. However, as the authors caution against using the subscales for any clinical purposes, and because the sample of teachers in this case study was so small, no conclusions could be drawn from this information. It is mentioned only as a point of interest.

Although only one teacher (Teacher C) scored low enough to fall into the "Low Technophobia" category, four other teachers (Teachers A and J in Phase I, Teacher Y in Phases II, and Teacher Z in Phase III) had scores very near the scoring cutoff line, with scores of 65, 66, 67, and 70 respectively. These scores were low enough to warrant increased scrutiny during the observations and interviews for signs of technophobia.

Results of the Computer Thoughts Survey (CTS)

As with the GATCS, the CTS is scored in such a way that higher scores indicate more positive thoughts and feelings toward computers and technology. Respondents who score between 69 and 100 on this scale are said to have "No Technophobia," a score of 61-68 indicates "Low Technophobia," and a score between 20 and 60 indicates "Moderate/High Technophobia" (Rosen & Weil, 1992, p. 30). The 11 teachers who returned the CTS (Form C) questionnaires had scores which ranged from a low of 59 (Moderate/High Technophobia) to a high score of 100 (No Technophobia). Again, the range of scores was much wider among the seven Phase I teachers (from 69 to 100) than among the Phase II and III teachers, whose scores ranged from 59 to 80. On average, Phase I teachers had slightly higher scores than their colleagues in Phases II and III (Phase I average 81.1 compared to a Phase II and III average of 73). Examination of subscales within the questionnaire revealed that on one subscale, Computer Enjoyment, teachers with low scores overall had lower scores on this particular subscale. However, as in the GATCS, the authors caution against using the subscales for any clinical purposes, and because the sample of teachers in this case study was so small, no conclusions could be drawn from this information. It is mentioned only as a point of interest.

Although only one Phase II teacher (Teacher Y) scored in the "Moderate to High Technophobia" category, three other teachers (Teachers F and H in Phase I and Teacher Z in Phase II) had scores near the scoring cutoff line, with scores of 73, 74, and 74 respectively. These scores were low enough to warrant increased scrutiny during the observations and interviews for signs of technophobia.

Results of the Computer Anxiety Rating Scale (CARS)

Unlike the GATCS and the CTS, the CARS is scored in such a way that higher scores indicate a higher level of technophobia or computer anxiety. Respondents who score between 20 and 41 on this scale are said to have "No Technophobia," a score of 42-49 indicates "Low Technophobia," and a score between 50 and 100 indicates "Moderate/High Technophobia" (Rosen & Weil, 1992, p. 30). The 11 teachers who returned the CARS (Form C) questionnaires had scores which ranged from a high of 70 (Moderate/High Technophobia) to a low score of 23 (No Technophobia). Again, the range of scores was much wider among the seven Phase I teachers (from 70 to 23) than among the Phase II and II teachers, whose scores ranged from 30 to 34. On average, Phase I teachers had slightly lower scores than their colleagues in Phases II and III (the Phase I average was 30.8, compared to a Phase II and III average of 32.3). Examination of subscales within the questionnaire revealed that on one subscale, Observational Computer Learning Anxiety, teachers with high scores overall had higher scores on this particular subscale. However, as in the GATCS and CTS, the authors caution against using the subscales for any clinical purposes, and because the sample of teachers in this

case study was so small, no conclusions could be drawn from this information. It is mentioned only as a point of interest.

Among Phase I teachers, Teacher C had the highest score, placing her in the Moderate to High Technophobia category, and Teachers A and F had scores which placed them in the Low Technophobia category. None of the Phase II or Phase III teachers showed evidence of technophobia on this measure.

The developers of the technophobia questionnaires suggest that respondents who score in the Moderate to High Technophobia category on any one of the three questionnaires should be considered to have moderate or high technophobia (Rosen & Weil, 1992, p. 30). Using this criterion, only Teachers C (Phase I) and Y (Phase II) could be described as having moderate to high technophobia. By the same token, the developers suggest that respondents who score in the No Technophobia category on all three questionnaires be considered to have no technophobia. Therefore, the questionnaire results indicated that Teachers B, E, and H in Phase I and Teachers W and X in Phase III had no technophobia. Respondents who score in the Low Technophobia category on one or more questionnaires, but who do not score in the Moderate to High Technophobia category on any other questionnaire should be considered to have low technophobia (Rosen & Weil, 1992, p. 30). Using this criterion, Teachers A, F, and J in Phase I, and Teacher Z in Phase II had low technophobia. In summary, of the 11 teachers who turned in the three questionnaires, five had no technophobia, four had low technophobia, and two had moderate to high technophobia. Considered another way, less than half (38.4%) of the teachers in this study had no technophobia or computer anxiety.

The results of the questionnaires were surprising. One would expect that Phase I teachers, who had had more training in the use of computers and the TLC model than their Phase II and III colleagues, and who had been using computers in their classrooms for almost a full school year at the time of the study, would have less technophobia than Phase II and III teachers. Instead, they had slightly more, on average. In addition, the range of scores among Phase I teachers was much wider, indicating that there were wide differences in the level of technophobia among the members of the Phase I group. The purpose of the subsequent observations, interviews, and review of documents was to see whether a relationship existed between the way teachers could be observed to implement the TLC model, including the attitudes they expressed about it, and the results of the three technophobia questionnaires.

Teachers' Computer Training Prior To TLC

The Preliminary Questions form asked teachers to list any computer training they had received prior to the IBM TLC training. These data revealed that teachers' prior experience with computers varied widely. Three of the 13 teachers (23%) reported that they had never used computers prior to the teacher training provided by IBM representatives as part of the implementation of the TLC model at Pioneer Elementary School. A fourth teacher stated that, prior to the TLC training, the only instruction she had received was that given to her informally by another teacher, while a fifth spoke of using the tutorials on a computer at another school in which she had worked as a means of trying to train herself. In all, five teachers had no formal training of any kind.

Five teachers (38%) recalled training they had received as part of a Duval County School System professional development program in the use of Tandy TRS-80's some years ago, and one had some training in the use of Apple computers, but said that it had taken place over 15 years ago. Only 4 of the 13 teachers interviewed (31%) had taken college courses on computers, and among these four, only the youngest and newest member of the staff reported having some training in the use of computers in high school. Clearly, the amount of prior training reported by the participating teachers varied, ranging from none at all, to some informal training, to formal training that was obsolete, to a small number who had taken computer courses in college.

Teachers' Personal Use Of Computers

During structured interviews, participating teachers were asked questions about their personal use of computers at home and at school. (The interview questions can be found in Appendix B, p.109.) An examination of interview responses revealed that teachers' use of computers at home varied, but that, overall, only a very few teachers owned up-to-date computer equipment. Three teachers (23%) reported that they had no computer at home at all. Of these three, one mentioned having access to games on a computer owned by a close friend, and that she had also written college papers on computers at the college campus. A fourth teacher stated that her son had two computers at home, but that both were broken and so were of no use to her. Several teachers had Apple computers at home, but described the computers as slow, outdated models. Only two teachers (15%) reported owning relatively new, up-to-date computers.

For Teacher H, who had bought an IBM computer for her husband and herself only three months before this research study took place, the learning process was taking place both at work and at home, with carry over from work to the home:

> We just got one in February, so we're still learning what to do with it and how to do with it. I've used it to type research papers, play a lot of games, helping my husband load [programs], which has been neat because I learned a little bit here and enough to kinda enable me to help him put in some programs. So if he gets stuck, he'll call me, 'Hey! I need to do this or that.' So we are in the learning process. It has saved me lot of typing, because you can correct right on there and we have spell check. It is wonderful.

For each of the teachers who did have a computer at home, whether outdated or relatively new, IBM or Apple, the most common use of the computer was for word processing, and the next most common use was playing games, such as Solitaire. Three teachers also mentioned Print Shop, a program they liked to use to make banners for classroom or hallway display, as well as greeting cards and posters. Only one teacher reported using her computer to send and receive e-mail and to explore the Internet as part of a college course she was taking, and none of the other 12 teachers reported using their computers to send or receive e-mail, pay bills, download information from Internet sources, hold on-line chats or conferences, or create and use spread sheets or data bases. Although many of the teachers expressed a desire to own a computer for home use, only a few had up-to-date computer equipment at home. Those who did have computers at home used them primarily for word processing, with only one teacher utilizing the computer more fully as a tool for information gathering and processing.

Teachers' Use Of Computers At School

Interview data revealed that teachers' use of computers at school was also limited, partly because of restrictions on the time necessary to become well acquainted with the software, and partly because of lack of training in the use of the teacher productivity software available on the network.. As with their use of computers at home, the most often cited personal use of the computer by teachers at school was for word processing, mostly of letters to parents. Only two teachers, both of them Phase I teachers, mentioned using the computer for anything other than word processing. One spoke of using Print Shop to make banners and cards, having obtained a stand alone copy of the software for use in her classroom through a grant she had written, and the other said that she had emergency lesson plans stored in the computer.

For Teacher D, whose room had only recently been networked, time was a significant factor in her use of the teacher productivity tools available to her on the network. "I was one of the last classes to get networked, so I really haven't had the opportunity," she said. "It's not something that I've gotten into yet. Maybe once I get enough time. . ."

Teacher B was more comfortable with the student programs than with the teacher productivity software.

> I feel comfortable working with the programs my kids work with. That's why I use The [Children's] Writing and Publishing Center. That's the one the kids use, and I feel most comfortable working with that. So I use more of the kids' stuff than I do the adults' stuff.

For other teachers, computers were seen as tools for use by students rather than by the teachers. In answer to the question of whether she used the computer at work, Teacher G quickly responded, "No, not for myself. Just basically for my students."

Teacher Y, a Phase II teacher who had only received a few TLC training sessions at the time of the study, looked forward to being able to use the teacher productivity programs:

> As far as me personally doing anything with them, I haven't progressed to that level yet. I have seen them [the other teachers] making up notices to parents, and I was told that some have put their lesson plans on the computer and those types of things. The one I am really anxious to get to is to have the computer average the grades. That would be the biggest asset for me, instead of having to sit and do it the old way with a calculator. So that's one feature that I am looking forward to and will be of great benefit to me.

Although a grade book program had been installed on the Local Area Network for teachers' use, and several teachers expressed an interest in using the program to record and average students' grades, none of the teachers had been successful in setting up and using the program at the time of the study. For Teacher A, who had used a gradebook program at a previous school, the complexity of the program available on the Pioneer Elementary School network was problematical: "There is a gradebook program on there [the network]. I have not been able to decipher it. I have tried and tried and tried. I just can't. It's over my head." Describing Gradebook Plus, the program with which she was familiar, she added,

> It took maybe two minutes to punch everything in and you hit a button and you had everything you wanted. Averages. I liked it because if I had a conference with a parent I could pull up that one child's [record] and show them. And it was so easy. This one probably is, too; I just haven't had time to figure it out.

Teacher's Attitudes Toward the TLC Training

Phase I teachers received five days of training from IBM representatives during "pre-planning," the week prior to the opening of the 1994-95 school year, and they continued their training on regularly scheduled planning days during the early part of the same school year. For teachers such as Teacher J, who had no previous computer training, the training made her apprehensive at first. When asked what she was expecting when she went into the training, she replied, "To be the last in the class!" Teacher C also spoke of how overwhelmed she felt at first:

> I guess at first I didn't think it was going to be like that, but once I started taking the workshops and seeing how it works, then I thought, "I don't know if I can do this.". . . In some cases it was just so much at one time that you just couldn't absorb everything, and then you just had to go back and filter out and go through the manuals and look and see and pull out things.

Teacher J described how relieved she felt to receive help from her more knowledgeable peers during the training:

> . . .believe it or not, when you are working on a computer, if you have someone that knows something about it sitting next to you, which I did, it was a big help. Sometimes when a trainer comes into the program and is doing the training program with you, there's so many in the class, until sometimes there is a little something that maybe you could miss out on, and someone who knows something about a computer can just help you follow up and turn on the light. Let you see what you might have missed.

When the Phase II teachers attended their first day of TLC training, Teacher J made it a point to visit the workshop to give teachers moral support:

> . . .I knew that they [Phase II teachers] were in there, and I could picture myself on that first day, never had any training, and if I could go in and just help someone maybe just see something. And sometimes one little thing you couldn't see can open your eyes to a lot of things. So that's why I did that. . . so they can

> understand the program like I have. Of course, I'm no genius in it, but I'm doing pretty good. I'm not bragging.

For other Phase I teachers, the training was fraught with problems. Several mentioned that the computers did not always cooperate, that there were glitches in the network, and that at least one day of training had to be curtailed and rescheduled because the equipment malfunctioned. The equipment problems, although transitory and eventually solvable, added to the frustration level. In Teacher F's words, ". . . I sort of felt like a lot of time was wasted on down time, waiting, fixing things, stopping." By far the most frequent comment, echoed by almost every teacher, was the spacing of the training sessions during the school year, including the frustration of learning a program during training and then getting back to the classroom to try it out and not remembering exactly how to do it. Teacher E's feelings were typical:

> The training that we've had so far mostly is, you know, looking at the software and using the software. I feel like it's so spread out...In one case we had the very beginning of the year, and then 18 weeks later we had another one. I guess you go through it and you look at things and stuff, and you come back to your classroom and you use it and you might have questions, but you don't see them again for 18 weeks or nine weeks. . . . Like, for instance, last time we did it, we did the spread sheets...and data base. We started out and used it, but now, if I tried to go over and do it now, I don't know that I remember it exactly. I know I wouldn't, because I tried to make a little chart and it's been so long, you don't use it, you lose it.

Another factor which frustrated teachers was that not all of them found every part of the training valuable. Teacher A felt that trying out learning centers and actually sitting down to do some of the same activities the students would eventually do was, as she termed it, "a bit much:"

> . . . we really didn't need to do all that. I think had she just told us what we needed to do we could have finished it. I shouldn't say we. I know I did and I know several other people did think it was a waste of time to actually do the centers ourselves. It's like we could have been learning more of other things.

The Leadership Factor

Teachers in all Phases were unanimous in praising their principal for taking the initiative and going after the funding to implement TLC. Each of them recalled clearly that it was the principal who first introduced the idea of TLC to the faculty, and recalled their excitement about getting computers in their rooms. A video of TLC being used with students in Mississippi was especially effective for Teacher H:

> Somebody brought a video, and we actually saw the thing twice. That was the first thing I remember...I thought it was wonderful. Here were these children in there, and they were reading their little plays that they had written and their little stories and everything, and I thought, "This is great!"

Teacher E echoed this sentiment:

> I guess the most appealing part to me was when they showed the video and they showed the children reading and doing things, writing poetry or little books, or whatever they did on their own, and seeing them work on it and just seeing what little, tiny children were able to accomplish. Then the teachers they showed on there, you know, saying how wonderful it was. That really was more appealing to me to see real life people selling it...I felt like the way they came across and what they were showing you, it looked realistic to me. That was neat to see the little kids.

Many of the teachers were invited to visit schools in Jacksonville and in Chiefland, Florida, to see computers in action For teachers who were apprehensive about the new model, the principal went out of her way to reassure them that they would get plenty of training, and that everything would be all right. In Teacher A's words:

> [The principal] kept assuring us that we were going to have plenty of training. She said, "I know there are people who are concerned about it." But she just kept

> telling us we would have plenty of training, plenty of training...Anytime it was brought up. She was always reassuring, "Don't worry, we're going to get you the training you need. Don't panic." She always let us know that there would be somebody to ask.

The principal, herself, felt strongly that effective training was crucial to successful implementation:

> The training I think has been crucial. The training had to be supplied when teachers needed it and what they wanted it to be. And I think if it had not been there, it probably would have fallen on its face. I think in many cases where I've heard of computer programs not getting off the ground and computers not being used, it was because people were not comfortable with them. The only way you get comfortable is having somebody introduce it to you and you get comfortable.

In addition to reassuring teachers that they would get the necessary training, the principal also let the teachers know that the computers were a tool for them to use to enhance their teaching, a tool which could be used as the teachers best saw fit.

> My personal philosophy is, you want something off the ground? You let people get used to it, you let them play with it a bit. With technology, people are going to kill it in a heartbeat if you do--and I think research backs that up--if you have a lot of mandates. In other words everybody will use it from x o'clock to x o'clock, and you will do such and such. Well, that's not going to fit everybody, because different teachers have different styles. . . .Why make the teacher uncomfortable and hate technology if you force it on them in a way that they're not comfortable with?

Teacher B gave the principal credit for changing the minds of teachers who were not in favor of computers :

> A lot of teachers when it was first introduced said, 'I don't want to do this. I don't want to do computers." [There has been a] big time turn around. [The principal] did that. She saw the cynics and she plucked them out and she took them to different places to see the computers, and she put them in charge, and she got them their computers first, and she did this and she did that. She saw who it was and she plopped them right in the middle of it and said, "See, you can do it!". . . She knew what she was doing. . . . I don't think we've told her enough how much we appreciated her.

From the outset, teachers were assured by the principal that they would get the training they needed and that they had a great deal of latitude in how they were to use the computers.

Classroom Diagrams

One of the most visible characteristics of the IBM TLC model is the physical arrangement of the classroom. The IBM training materials contained a recommended classroom layout scheme, in which the requisite four to five computers were arranged together in a group, and the tables, chairs and other classroom resources were positioned for small group learning. Descriptions of learning centers are also contained in the IBM training materials (IBM, n.d.b. Training Manual, TLC, K-6). A typical learning center might have a table, with four to six chairs around it. Each classroom could, of course, have as many learning centers as could be physically contained in the room, but as a minimum the authors of the IBM materials suggested six leaning centers for classrooms in which Writing to Read (WTR) and Writing to Write (WTW) were being used, and a similar set up for grades 3-5: (a) the computers; (b) a work journal center; (c) a writing/typing center; (d) a tape library; (e) an activity center, and (f) a "Make Words" center (for WTR and WTW) or language arts center. (IBM, n.d.b.). It is also important that there be a sufficient number of learning centers in the classroom, so that each child can be accommodated in one of the learning centers, with no more than 4-6 students per center.

If this recommendation had been followed explicitly at Pioneer Elementary School, where there were 25-30 students in each classroom, each Phase I classroom

would therefore be expected to have six learning centers, one of which would be the computers. The first task then, was to observe whether the classrooms of Phase I teachers at Pioneer Elementary School were arranged in a manner consistent with recommendations by the authors of the IBM training materials, and to ascertain whether learning centers had been set up.

Upon entering each of the nine Phase I classrooms for the first observation visit, the researcher sketched a diagram of the room's layout. While not as accurate in terms of dimension and detail as an architectural drawing, the diagrams nonetheless showed how each of the nine Phase I teachers in this study arranged the classroom furniture and equipment, and whether there were visible signs of the recommended learning centers described in the IBM training materials. The nine rough sketches were later redone using a computer drawing program, and appear in Appendix G, pp. 119-128. Because the randomly selected Phase II and Phase III teachers included in this study had not received their full complement of computers or training at the time of this study, no diagrams were made of their classrooms.

Each classroom was observed three times, for a period of between 45 and 55 minutes. One additional observation each was scheduled for Teachers D and G, who had failed to return the three technophobia questionnaires. Observations were scheduled in advance with each teacher, and took place during a time set aside by the teacher as TLC or computer time. During each observation, the researcher used a laptop computer to record details of students' activities, movement around the classroom, and interaction between students, as well as interaction between students and their teacher. Of special

interest to the researcher were the students' movement from one learning center to another and the movement of the teachers as they supervised and worked with the students, because IBM training materials encouraged teachers to move around the room, acting as facilitators, rather than sitting with a group to give direct instruction, and specified the use by students of learning centers.

An examination of the nine classroom diagrams revealed that the classroom arrangements appeared to fall into three major categories, which the researcher will call (a) TLC-Oriented, (b) Transitional, and (c) Traditional. Of the nine Phase I classrooms, five were determined to be TLC-Oriented in their physical arrangement, three were determined to be Transitional, and one was determined to be Traditional. The following sections describe the three types of classrooms, and include data collected during classroom observations, in which students and their teachers were observed as they moved about the classroom during TLC instruction.

The TLC-Oriented Classroom

Each of the five classrooms which the researcher identified as TLC-Oriented classrooms was arranged differently. (See Appendix G, p. 119-123.) However, in each case the arrangement of the classroom furniture and equipment clearly indicated the presence of learning centers. In three of the five classrooms, tables of various sizes were placed around the room, each with 4-6 chairs, with no student desks in the room in all. In two other classrooms, traditional student desks were being used, but they were arranged in small clusters, typically with students facing inward toward each other, much as they might do if they were sitting around a table. Each learning center had some materials or

equipment available for student use that was different from the materials or equipment being used in any of the other centers. At least one table in each TLC-Oriented classroom had a tape recorder, with earphones and books for each student, some learning centers had drawing supplies, others math manipulatives, others writing materials, etc. These centers were, for the most part, consistent with recommendations in the IBM TLC training materials. Most teachers also had a reading center or "book nook" set up, some with carpet on which students could sit on the floor and read, others with bean bag chairs, still others with traditional table and chairs. In some cases, space permitting, an open area in the center of the room was used by the teacher as a gathering place, where the entire class could sit in the carpet and listen to whole group instruction or to directions from the teacher. In other cases, students sat at tables or desks for the purpose of whole group instruction or to receive directions. In all five cases, the TLC-Oriented classrooms were places in which there was a great deal of student movement, with students moving at a signal from the teacher from one learning center to the other.

Teacher B's signal for movement was a rhythmic clap, which the students immediately echoed. Once she had their attention, she asked them to point to the next center to which they would be moving. "One, two, three, look at me. Show me where you're going," she said. Each child pointed to a center. Several students were reminded that they needed to complete work in a center different from the one to which they pointed. Once all were sure of where they were going, Teacher B called, "Change!" and the students moved to the new center. In Teacher H's room, the teacher used a small hand bell to get students' attention, then spent several minutes asking individual students what

assignments or projects they needed to complete, and then told them to move. Teacher D simply called out, "It's time to change," and the students moved quickly from one center to the next, always traveling in a counterclockwise direction. In Teacher C's room, students were assigned to groups, which had color names, and learning centers, which had numbers. She called out the group names and directed them to a numbered center, "Brown group will go to 1, Yellow to 2, Purple to 3, Pink to 4, Green to 5, Red to 7." For students, movement from one center to another seemed a pleasure. In Teacher E's class, one eager young boy was literally bouncing in his seat. His face shone with excitement and big smile as he pointed to the various centers in the classroom and said, "When I'm done here, I'm going there, then I'm going there, and there, and there!"

The Transitional Classroom

Transitional classrooms were those in which the arrangement of the classroom furniture and equipment clearly indicated a combination of the traditional arrangement of student desks in rows and the presence of some learning centers. (See Appendix G, pp. 124-127.) In Transitional classrooms, student desks and chairs were typically arranged in rows in the center of the room, with learning center tables on the periphery of the room. In Transitional classrooms, students received whole group instruction or directions from the teacher at their desks. They then moved to the computers or to the learning centers, with at least one group of students remaining at their desks to do traditional seat work. Transitional classrooms typically had fewer learning centers that TLC-Oriented classrooms, ostensibly because the students who remained at their desks comprised, in a sense, a learning center.

In one Transitional classroom, three tables at the back of the room were set up as learning centers: one had an assortment of electronic hand-held games, the other was a reading table. At the third table, Teacher J was helping individual students. Five students were at the computers, and the remainder of the students were at their desks, working in a language arts workbook.

The room was very quiet, with students talking quietly to one another or concentrating on their tasks. Teacher J kept an eye on the students at the computer, and when she saw that most of them were reaching the end of the spelling lesson on which they were working, she called, "Time!" and the students lined up quickly and moved to different centers. "Their spelling has really improved this year," she said, "In fact all their work has improved. I really wouldn't have thought it at first. I thought it was a come on. I think the [California Test of Basic Skills] CTBS scores will be real good."

In another Transitional classroom, five students were at the computers, some working on a program called People and Things, others working on Action and Description. Most of the class was doing seat work. A small group of girls was working with Wrinker cards, which were to be used as story starters, and several boys were looking at books in the book center. Teacher F had set a timer, and when it went off, students put away what they were doing and prepared to move to another center. The teacher called, "Charlene, what center are you in?" Charlene answered, "Journal," but she was not writing in her journal at a learning center; she was sitting at her desk in one of the traditional rows of desks. A few moments later, the teacher cautioned a boy who was arguing with the boy next to him, "Todd, sit down and do the center you're in." The boy

sat down at his desk and began to work. When she spotted a boy who was idle, she said, "Jasmine, tell your partner what center we're in now." Clearly, learning centers tasks in this room could be accomplished at a student desk and did not require a physical location in which students worked together.

The Traditional Classroom

Traditional classrooms were those in which student desks were placed in traditional rows, and computers were the only learning center in the classroom. (See Appendix, G, p.128.) Students received whole group instruction or directions from the teacher at their desks. Then one small group of students at a time were allowed to go to the computer, while the remainder of the class stayed at their desks. At a signal from the teacher, another group of students went to the computer, and the students who had been at the computer returned to their desks.

In the one classroom identified as Traditional, the atmosphere was quiet and orderly, and the assignments for the day were written on the chalkboard. Teacher G announced that it was time for spelling and quietly called the names of those students who were to go to the computers. The students got up from their desks, went to the computers, logged on, and put on their headsets. In less than a minute they were all working on the same program, called Test Run, a spelling program. Meanwhile, the teacher set the remaining students to work on a lesson in their spelling books involving commas in a series. She walked down the rows of desks, looking at each students' work, then came to the front of the room and asked for their attention to explain the rules about commas in a series, saying. "The reason I am going over this is because I saw several

papers in the first row that were not right." The students at the computers, who had their headsets on, their backs to the class, and who were focused on their computer monitors, could not hear or see the teacher's lesson on commas and did not hear or take any part in the discussion and practice that followed. This procedure was repeated several times, and each time the students at the computer focused on the monitors and did not take part in the lesson being taught to the rest of the class. No evidence of other learning centers was visible in the classroom.

Results of the Review of Documents

The documents which were reviewed for this study included the Pioneer Elementary School Improvement Plan, parent and staff surveys, and the school's Title I Schoolwide Project application. Each of these documents corroborated the interview data from teachers and staff members, in that each document substantiated the commitment of school staff to improving students' education through use of technology. The School Improvement Plan contained specific goals for acquisition of equipment and materials, as well as training goals and student achievement goals. These goals were reiterated in the federal Title I Schoolwide Project application, and a substantial portion of the budget was set aside for computer equipment and software as well as to defray teacher training costs. School Climate Survey results reflected that a majority of staff and parents were in favor of more technology for instruction. These documents clearly indicated that the school staff and community had set specific goals for the increased use of computers in the school and had aligned those goals with specific budget allocations.

The Florida School Reports (1992-95) corroborated the principal's contention that her staff was relatively stable, an argument which helped her convince district officials to allocate funds for the initial investment in equipment and wiring. These reports also indicated an steadily increasing number of minority students in the school, as well as an extremely high mobility rate (over 66%). These were factors mentioned by many of the teachers during their interviews, and the high number of minority students in each classroom was evident during classroom observations.

The documents which proved most problematic were the computer printouts which were to have shown student progress, and the media specialist's "Problem Sheets." Although some software programs produced clear and usable information on student progress, many, including the Writing to Read and Writing to Write programs, did not. In addition, teachers reported that what the computer report said was not always accurate. In some cases teachers had become concerned enough to watch a certain student carefully, making note of how long the student was logged on, what lesson they did, and what score they got, only to receive a computer printout on which the information did not agree with what the teacher had observed. To complicate the matter even further, students in primary grades were encouraged to work in pairs. One of the pair might log on, but the computer could neither report what each student had accomplished nor which student had done which part of the work.

The media specialist's problem sheets told of a year-long litany of equipment and networking problems, problems which were mentioned by each of the Phase I teachers during their interviews. Although no equipment failures occurred during the period of the

study (other than having to shut down the equipment one afternoon during a heavy thunderstorm), teachers were obviously frustrated with the equipment. Teacher F's frustration was typical:

> . . . I was not expecting as many problems as we had. There were a lot of bugs in it. . . it was just so horrendous the problems we were having. . .just things that come up with the computers that wouldn't work, and you don't know what to do, and you have to send for somebody, and you can't get someone if the printer doesn't print or is printing sideways or on top of something, you know. You try to stop and figure it out, and the kids are going wild because there is no wait time they can handle.

Examination of Outliers

Among the nine teachers who took part in Phase I of the TLC implementation at Pioneer, only one (Teacher C) had a score on the three Rosen and Weil technophobia questionnaires which placed her in the Moderate/High Technophobia category. Yet, during the first classroom visit, during which the classroom diagram was made and the interaction of teacher and students was observed, it appeared that Teacher C had arranged her room in very much the way recommended by the IBM training materials. Learning centers had clearly been set up, and students were moving among the centers.

Her interview, however, elicited some interesting responses, some of which contradicted other, more positive responses. When asked what she found least appealing about the idea of implementing the new model, Teacher C replied:

> It became a little stressful trying to match my...program with what they wanted from us, and it was like trying to fit all of these things in plus do what you normally do. It began to get kind of stressful, and they just said, "Just relax and do what you're doing and just kind of work around it." . . . I thought, "I don't know if I can do this."

When the time came for the researcher to return for two subsequent visits, the teacher, who had turned in a schedule of time periods during which she would be using TLC, was not using the computers, but was teaching the class using traditional whole group instruction. The researcher began to look into the classroom regularly during the three weeks of the study and found that Teacher C, who for the most part spoke enthusiastically about TLC, was in fact not using the computers very much at all. Two more observations were eventually set up, during which the students were obviously very eager to use the computers. "We didn't get our 'puter time last week," confided one student to the researcher, "I hope I get to do it today."

Three other Phase I teachers (Teachers A, F, and J), whose scores on the technophobia questionnaires indicated that they were in the "Low Technophobia" category, were the same teachers who were described in a previous section as having Transitional classrooms. That is, they had adopted some parts of the TLC concept, but still had their rooms arranged in traditional rows of desks, with learning centers at the periphery. In addition, many of the centers, such as one with electronic learning games, were not the type of learning centers advocated in the training materials. Nonetheless, each of these teachers seemed enthusiastic about TLC, and felt that TLC had influenced the way they taught. For Teacher A, the changes started late in the year:

> It changed this year, lately, in the last few months, because I used to let them [the students] do the centers as free choice. I let them pick whatever they want to. Lately, I have been pulling up what I want to do and kind of tracking what they're doing, so I can see if they're getting in there and playing or if they are really getting down to business and doing some work. . . . And they take turns through the whole class. So, I never imagined myself doing that.

She admitted that she still harbored some fear of computers and that she herself did not

use them Asked what it would take to get her to use computers, she replied:

> For me to use them? I am just going to have to get over my phobia and get down to it. I'll probably end up taking some courses.

Asked how she would feel if the computers were removed, Teacher A said:

> I'd be very upset. Yes. Very upset. Because they are part of our classroom now. Part of our curriculum. That'd be like taking one of our textbooks away and say, "Here, teach!"

Clearly Teacher A was struggling to overcome her anxiety about computers and learn how to use them for the sake of the students.

Two Phase I teachers (Teachers D and G) did not return the technophobia questionnaires. Teacher G was the one whose classroom was described earlier in this chapter as the Traditional classroom. Her interview was revealing in that each response was short and at times curt. She had had no previous computer training, had no computer at home, and did not use computers at school for personal or professional tasks. She did, however, approve of using the computers for writing:

> ...I know that there is a great need on this grade level for writing because of the [State of Florida and district] writing assessment. So that's basically what was appealing to me, because I know the students do need to increase their writing ability, and I though this would be a good enhancement for it.

Interestingly, the same writing samples the researcher had observed during a preliminary visit to Teacher G's classroom in February 1995, were still displayed on the classroom bulletin board during the May 1995 study period.

Although she was one of the first to get her computers, Teacher G was also unable to handle some of the equipment problems which plagued all the teachers:

> It was terrible, terrible, terrible. I mean, one day I started doing something and something went wrong and it was like, I can't believe this is happening, you know? When you're motivated and you are ready to go on and do what you have

> to do, and all of a sudden BOOM! And because I'm not that experienced, I don't always know what to do about a problem, and that kind of did get me unhappy. If you are experienced and you know how to handle this, then okay. But if you're not, then that can present some serious problems.

Although many of her responses to other interview questions gave the impression that she was going along with the TLC program, Teacher G was clearly adhering closely to traditional teaching techniques and was not using the computers as often or as effectively as she might have. Although she did not turn in the technophobia questionnaires, the researcher was able to detect technophobia in replies such as the one quoted above.

Teacher D, who also failed to turn in the technophobia questionnaires, was among those whose classroom arrangement was determined to be TLC-Oriented. That is, she had learning centers set up in the room, and students were observed moving from one center to the other. In fact, as the researcher moved up and down the hallways during the day, it appeared that Teacher D used the learning centers almost all day every day. However, at no time, neither during scheduled observations nor during casual observation from the hallway was she ever up and moving around the room to act as a facilitator. Each time the researcher observed her, the teacher was seated at a table, giving one of the groups small group instruction, either in reading or in math. The remainder of the students worked at learning center tasks, including the computers. Her room was always orderly and controlled, and students always appeared to be on task. Those who briefly got off task or who began to wander around the room were always immediately called to by the teacher and redirected. Teacher D seemed to have a knack for teaching the small

group and keeping a watchful eye on the rest of the class at the same time. She explained that she had always been center oriented, and that she was enthusiastic about having an entire center devoted to computers:

> I've thought it real helpful because it gives a group of kids something to do, that they're doing something academic the whole time. So that's helpful right there. . .and that frees me up to work with one group, and I know the other group is getting something they need.

Asked whether TLC had changed the way she taught, Teacher D replied:

> Not a lot, because I was really center oriented before, and that's a lot of what they were talking about. Using the computers as one of your centers. And I did that, so for me it wasn't a big change.

Clearly, Teacher D was entirely comfortable with learning centers, and was making frequent and good use of the computers. But she preferred teaching small groups rather than move around the room, acting as a facilitator. Furthermore, she did not feel that she had to be locked in to doing exactly what the TLC manuals said, and she explained that flexibility to utilize the computers in her own way had been given to her by the principal:

> . . . it was reinforced by our principal, that this is to help us, help us enrich these kids. Not just as a sole factor. And we have to figure out where it helps us and helps our kids.

Teacher D did not show any sign of technophobia, in fact she was very confident of her ability to use computers effectively in her teaching. Indeed, she had her own very definite ideas of how she would adapt the TLC model for use in her classroom. These ideas differed only slightly from the TLC model, in that she preferred not to move about the room and act as a facilitator. In all other respects, her classroom followed the TLC model.

Summary of the Results

Overall, the staff at Pioneer Elementary school showed a strong commitment to the increased use of technology to enhance and improve instructional delivery. However, despite intensive training, five of the nine Phase I teachers showed evidence that they still harbored some anxiety toward computers. This anxiety showed most clearly in the degree to which they implemented the program. Of the five teachers, three had chosen to adopt certain elements of the TLC model, but not others. These classrooms were termed Transitional by the researcher, and were characterized by the physical juxtaposition of traditional rows of desks, with learning centers at the periphery of the room. One teacher was making some use of the computers, but clearly was most comfortable with traditional, whole group instruction. This classroom was termed Traditional by the researcher. The last technophobic teacher, whose classroom appeared to be TLC-Oriented, was found to be carefully avoiding the use of computers. Teachers who had no technophobia were implementing the TLC model fully, except for one teacher who preferred not to incorporate the role of facilitator, and stayed seated rather than moving about the room. The results of the questionnaires were confirmed through interviews, observation, and review of documents, and indicated a relationship between teachers' level of technophobia and the degree to which they implemented the TLC program.

The following chapter includes a discussion of the results found in this case study, and suggests avenues of further research.

CHAPTER V

DISCUSSION

Review of the Problem and Research Methodology

The problem in this study was to gain knowledge that may be useful in implementing computer-assisted instructional delivery in elementary schools. The study was designed to explore the relationship between technophobia and teachers' implementation of the IBM Teaching and Learning with Computers (TLC) concept at Pioneer Elementary School in Jacksonville, Florida.

The study utilized case study methodologies as well as a validated set of three technophobia questionnaires (Rosen & Weil, 1992) in order to achieve a contextual understanding of how teachers were implementing the TLC model, and to determine whether there was a relationship between technophobia and the extent to which the teachers implemented the new model. The case study methodologies used were (a) structured interviews, (b) classroom observation (including making a sketch of the physical arrangement of each classroom), and (c) a review of documents. The three questionnaires utilized were (a) the Computer Anxiety Rating Scale (CARS) (Form C); (b) the Computer Thoughts Survey (CTS) (Form C), and (c) the General Attitudes Towards Computers Scales (GATCS) (Form C) (Rosen & Weil, 1992).

The study was guided by the following questions:

1. What is the relationship between teachers' scores on the CARS (Form C) and the extent to which they implemented the TLC model?

2. What is the relationship between teachers' scores on the CTS (Form C) and the extent to which they implemented the TLC model?

3. What is the relationship between the GATCS (Form C) and the extent to which they implemented the TLC model?

The study involved a total of 13 classroom teachers, including 11 teachers in grades K through five, and two Exceptional Student Education teachers. However, the study focused mainly on the nine teachers of grades K-3, referred to throughout the study as Phase I teachers, because they were the only ones who were fully equipped and trained to implement the TLC model at the time of the study.

A Preliminary Questions forms filled out by each teacher at the time of their structured interview established the fact that the teachers at Pioneer were a varied group, ranging in age from 25 to "over 50," in teaching experience from 2 years to 35 years, and averaging 7-8 years at Pioneer Elementary School. Their prior training and experience with computers ranged from those with no training at all to a few who had taken computer courses in college. Overall, the majority of the teachers had relatively little prior training, or had training that was now obsolete. Only two teachers owned up-to-date computers in their homes, several had older models, most had none. Those who had computers used them primarily for word processing; only one teacher was skilled enough to navigate the Internet and send and receive e-mail.

Implications of the Classroom Arrangement

The physical arrangement of the classroom into learning centers was recorded by means of making a sketch of each Phase I classroom. These sketches revealed that five of the Phase I teachers were what the researcher termed "TLC-Oriented," that is learning centers were clearly in evidence. Three classrooms were defined as "Transitional," that is learning centers were placed on the periphery of the room, and the students were seated in traditional rows. One classroom was defined as "Traditional," in that the only learning center in evidence was the group of computers; the students were seated in traditional rows, and they received traditional whole group instruction. The visual data, combined with further observation of student and teacher movement and interaction, revealed some further gradations among these categories. One teacher's classroom had learning centers in evidence, but she did not move around the room in the role of facilitator. Instead, she worked with small groups. Thus the classroom looked TLC-Oriented, and was for the most part in synchrony with the TLC model as described in the training materials, except for the one element of teacher movement/style. In another classroom, the physical arrangement of the room suggested a TLC-Oriented classroom, but it was discovered that the teacher was not using the computers as often as she indicated.

Implications of Questionnaire Results

Of the 13 teachers who were asked to complete questionnaires. 11 returned the forms. Interview and observation data from the two teachers who did not return the forms were carefully analyzed to detect evidence of technophobia.

Scores on the GATCS indicated that only one teacher in Phase I had a score low enough to fall into the "Low Technophobia" category. However, two other Phase I teachers and one teacher each in Phases II and III had scores very near the cutoff line. The teacher with the lowest score proved to be one whose classroom looked as if it were TLC-Oriented, but who was actually not using the learning centers and computers as much as her schedule indicated. Each time the researcher observed her, this teacher was using whole group instruction. When she did use TLC, her students reported to the researcher that it had been some time since they had used the computer. In short, while the teacher talked enthusiastically about TLC and had arranged her room in learning centers, her actions and her scores on the technophobia questionnaires--especially the GATCS--revealed that she was not yet truly comfortable with the TLC model, and was not implementing it on a daily basis. The two Phase I teachers who had borderline scores on the GATCS had classrooms in the Transitional category. One admitted freely that she had a phobia but was trying to get over it; the other spoke enthusiastically about computers, but her idea of learning centers was actually seat work. In both cases, the teachers were implementing the TLC model only to a certain degree.

Teachers with higher scores on the GATCS were fully implementing the TLC model, were comfortable with computers, had TLC-Oriented classrooms, and showed in both their action and words that they had successfully adopted the TLC model.

In answer to the research question, what is the relationship between teacher's scores on the GATCS and the extent to which they implemented the TLC model, one would have to say that, for the most part, the data indicated that teachers who scored

higher on the GATCS were those who fully implemented the TLC model and whose classroom were TLC-Oriented. Those with lower scores, which were close to the "Low Technophobia" scoring cutoff, implemented the TLC model less fully, adapting a combination of TLC and traditional styles which the researcher has called Transitional.

However, the teacher who scored lowest on the GATCS had a classroom which outwardly looked like a TLC-Oriented, and she talked enthusiastically about using computers. However, observation and interview data revealed that the teacher was not really using the computers or the learning centers as often as she indicated, and that she actually preferred traditional, whole group instruction. In this case, the results of the questionnaire and the first observation seemed to be at odds. Continued observation was necessary in order to establish what the teacher was actually doing.

The results of the CARS and the CTS were exactly similar, although slightly different teachers were involved. In each case, positive scores were consistent with teachers who had TLC-Oriented Classrooms, spoke confidently about their use of computers, and organized their instruction to make optimal use of computers and learning centers. Negative scores were consistent with teachers who had Transitional classrooms, who made use of the computers and learning centers in slightly less effective ways, and who were less confident when speaking about their use of computers.

In answer to the question, what is the relationship between teachers' scores on the CARS and the extent to which they implemented the TLC model, one would have to say that, for the most part, the data indicated that teachers who scored lower on the CARS fully implemented the TLC model and had classrooms which could be easily identified as

TLC-Oriented. Those with higher scores, which were close to the "Low Technophobia" scoring cutoff, implemented the TLC model less fully, adapting a combination of TLC and traditional styles which the researcher has called Transitional.

In answer to the question, what is the relationship between teachers' scores on the CTS and the extent to which teachers implemented the TLC model, the data indicated that teachers who scored higher on the CARS were those who fully implemented the TLC model and whose classroom were TLC-Oriented. Those with lower scores, which were close to the "Low Technophobia" scoring cutoff, implemented the TLC model less fully, adapting a combination of TLC and traditional styles which the researcher has called Transitional.

The two teachers who did not return questionnaires proved extremely interesting. Teacher G had a classroom defined by the researcher as Traditional, in which the only learning center in evidence was the computers, and where traditional whole group instruction was used exclusively. Students took turns at the computers while the teacher continued to teach the remainder of the group. The teacher spoke as if she, too, were fully implementing the TLC model, but her classroom arrangement, her actions during observations, and her admission that she was unhappy with the many problems she had experienced with the equipment made it obvious that she was still uncomfortable using computers and was, at the time of the study, still unwilling to implement the TLC model to any appreciable extent.

The other teacher who did not return the questionnaires, Teacher D, was quite the opposite. She was confident about her use of computers, skilled at using learning centers,

which had always been a favorite teaching strategy, and her classroom had learning centers clearly in evidence. Except for the fact that she chose not to move about the classroom in the role of facilitator and chose instead to remain at a table where she could teach small groups, this teacher was indeed implementing TLC, but was doing so while incorporating her preferred teaching style.

In summary, the questionnaires were extremely helpful in identifying teachers with some degree of technophobia. However, the data from observations (including sketches of the physical arrangement of the classrooms) and interviews painted a much clearer and more detailed picture of the ways in which teachers were, or were not, implementing the TLC model. In almost all cases, the questionnaire results and the interview and observation results were synchronous. The review of documents corroborated the commitment of the school staff to the utilization of technology as a means of school improvement and helped to identify the many technical difficulties which have frustrated and challenged the staff throughout the first year of implementation.

Implications for Phase II and Phase III

As the staff of Pioneer Elementary School continues to implement the TLC model, it will be important for school leaders to remember that teachers are a very varied group, and that among them there may be those who are technophobic. Continued use of the Rosen and Weil (1992) technophobia questionnaires may be a useful tool to help identify those with computer anxiety, so that they may receive extra training, attention, and support. Among the four Phase II and III teachers randomly chosen for this study,

two had scores which indicated that they fell into the Low and Moderate/High Technophobia categories. These teachers will need training, encouragement, and support, as well as daily experience with computers in the classroom, in order to conquer their anxiety and make optimal use of the new equipment and training. All teachers must be carefully monitored, and the principal must become a careful observer and counselor, providing constant encouragement and motivation to the teachers.

Recommendations for Further Study

Each case study is unique, involving a varied set of characters in particular circumstances. The teachers at Pioneer Elementary School were a varied group, with varying backgrounds, experience and attitudes toward computers. The use of case study methods in program evaluation such as this is essential. Had this study reported only the results of the technophobia questionnaires, the results might have been misleading. The juxtaposition of qualitative and qualitative methods, while not easy, yielded far more detailed, useful information that the results of quantitative measures alone.

As a result of this study, the following recommendations for further study are suggested:

1. A longitudinal study of student achievement at Pioneer Elementary School, correlated to the three teacher implementation styles defined in this study

2. Continued case study at Pioneer to ascertain whether, over time, teachers continue to implement the TLC in the same, or different ways,

2. Replication of these and other case study methods, including the technophobia questionnaires, at other elementary schools in which the TLC model is being implemented,

3. Case studies of other computer-assisted instructional delivery models.

Cambre and Cook (1985) reminded us that computer anxiety is an anxiety state and can be changed over time. For school leaders, the implications of technophobia among teachers are challenging and complex, especially in matters of staffing, training and instructional leadership. As more money and time are invested in technology in the school setting, the need for careful assessment of computer-assisted instructional delivery will become ever more critical. This study demonstrated clearly that computer anxiety, or technophobia, can and did affect the way in which teachers at one school made use of the equipment provided to them. In spite of extensive training and almost a full school year of computer use, some teachers were still uncomfortable incorporating computers into their instructional delivery. It must therefore be recognized that future study of the effect of computer-assisted instructional delivery on student achievement must also take into account the degree to which teachers are enabling and allowing students to use technology. It is highly recommended that in examining the implementation of computer-assisted instructional delivery models, researchers take into account the possibility that some teachers may harbor anxiety toward computers, and that they utilize both qualitative and quantitative methods to paint a clearer, more detailed picture of how technology is actually being used.

APPENDIX A

THREE TECHNOPHOBIA QUESTIONNAIRES

GENERAL ATTITUDES TOWARD COMPUTERS SCALE
(Form C)

The following statements address general attitudes toward computers. Place a check (✓) under the column that describes your level of agreement (Strongly Agree, Agree, Neutral, Disagree or Strongly Disagree) to each statement.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1. Computers can save people a lot of work.					
2. It takes a good math background to learn to use a computer.					
3. You need to know how to use a computer to get a good job.					
4. Computers can help solve society's problems.					
5. Computers are taking over.					
6. Computers can increase control over your own life.					
7. Computers increase the amount of time we have for other activities.					
8. Men are better with computers than women.					
9 Computers may eventually act independently of people.					
10. In the future there will still be jobs that don't require computer skills.					
11. Computers are good teaching tools.					
12. Use of computers can cause physical health problems.					
13. Computers prepare students for the future.					
14. Computers are taking jobs away from people.					
15. Some ethnic groups are better with computers than others.					
16. There is an overemphasis on computer education in this society.					
17. Computers can ruin interpersonal relationships.					
18. In five years everyone will need to know how to operate a computer.					
19. Computers create new jobs for people.					
20. Computers will never be smarter than people.					

COMPUTER THOUGHTS SURVEY
(Form C)

Please check (✓) the box that indicates how often you currently have each of the following thoughts when you use a computer or think about using a computer.

	Not at All	A Little	A Fair Amount	Much	Very Much
1. I am going to make a mistake.					
2. This will be fun.					
3. Everyone else knows what they are doing.					
4. I enjoy learning about this.					
5. I like playing on the computer.					
6. I feel stupid.					
7. People will notice if I make a mistake.					
8. This will shorten my work.					
9. I am totally confused.					
10. I know I can do it.					
11. I am willing to give it a try.					
12. I hate this machine.					
13. I'm afraid I'll wreck the program.					
14. I can get help if I get stuck.					
15. What if I hit the wrong button?					
16. This is really interesting.					
17. I'm too embarrassed to ask for help.					
18. Others have learned this and so can I.					
19. I feel overwhelmed by how much I don't know.					
20. I won't be able to get the computer to do what I want.					

COMPUTER ANXIETY RATING SCALE
(Form C)

The items in this questionnaire refer to things and experiences that may cause anxiety or apprehension. For each item, place a check (✓) under the column that describes how anxious (nervous) each one would make you at this point in your life.

	Not at All	A Little	A Fair Amount	Much	Very Much
1. Thinking about taking a course in a computer language					
2. Taking a test using a computer scoring sheet					
3. Applying for a job that requires some computer training					
4. Sitting in front of a home computer					
5. Watching a movie about an intelligent computer					
6. Looking at a computer printout					
7. Getting "error messages" from the computer					
8. Using the automated bank teller machine					
9. Visiting a computer center					
10. Being unable to receive information because the "computer is down"					
11. Learning to write computer programs					
12. Thinking about buying a new personal computer					
13. Erasing or deleting material from a computer file					
14. Taking a class about the use of computers					
15. Re-setting a digital clock after the electricity has been off					
16. Learning computer terminology					
17. Reading a computer manual					
18. Watching someone work on a personal computer					
19. Programming a microwave oven					
20. Learning how a computer works					

APPENDIX B

INTERVIEW QUESTIONS

INTERVIEW QUESTIONS

1. Please describe how you use computers, at home and at work.
2. Please tell me about how and when you first heard about TLC?
3. What aspect of TLC was most appealing to you? least appealing?
4. How did you feel about incorporating TLC into your style of teaching?
5. What did (do) you expect from the TLC training?
6. Please describe a TLC training day, from the time you arrived, until you left.
7. What did you get out of the TLC training, and was it all you thought it would be?
8. In what ways has your TLC training changed the way you teach?
9. Please tell me about the equipment, software, and other teaching materials you have now, and tell me if they are what you expected?
10. How do the TLC software and other materials fit in with your core curriculum?
11. Please describe a typical day in your classroom, starting from when you arrive in the morning until quitting time, whenever that is?
12. How has TLC affected the way teachers in this school interact with one another?
13. How has the TLC experience changed your relationships with your colleagues?
14. How have your students reacted to having computers in the classroom?
15. Do you think that computers will improve your students' overall achievement?
16. Is there anything your students can do now, with computers, that they couldn't do before?
17. How do you think your present students will be using computers 10 years from now?
18. How do you think you will be using computers 10 years from now?
19. Have computers made your work as a teacher easier, or harder?

APPENDIX C

PRELIMINARY QUESTIONS FORM

PRELIMINARY QUESTIONS

Name _____

Age _____

Highest College Degree _____

Years of Teaching (include the current school year) _____

Years of Teaching at Pioneer Elementary School _____

Computer training prior to TLC training

APPENDIX D

SCHEDULE OF INTERVIEWS AND OBSERVATIONS

SCHEDULE OF INTERVIEWS AND OBSERVATIONS
PIONEER ELEMENTARY SCHOOL
JACKSONVILLE, FLORIDA
MAY 8 - MAY 26, 1995

Teacher	Interview Date	Observation Dates
A	5/12/95	5/11; 5/18; 5/22
B	5/15/95	5/12; 5/23; 5/25
C	5/22/95	5/11; 5/19; 5/26
D	5/17/95	5/15; 5/17; 5/22; 5/23
E	5/24/95	5/18; 5/22; 5/26
F	5/19/95	5/23; 5/25; 5/26
G	5/25/95	5/19; 5/23/ 5/25; 5/26
H	5/18/95	5/11; 5/16; 5/23
J	5/26/95	5/12; 5/16; 5/23
W	5/16/95	NA
X	5/23/95	NA
Y	5/23/95	5/18; 5/22; 5/25
Z	5/12/95	5/12; 5/18; 5/25

APPENDIX E

DOCUMENT SUMMARY FORM

DOCUMENT SUMMARY FORM

Title of
Document_____

Source_____

Author_____

Published by_____

Date of Publication _____

Topic_____

Summary of Contents

Applicable Codes

APPENDIX F

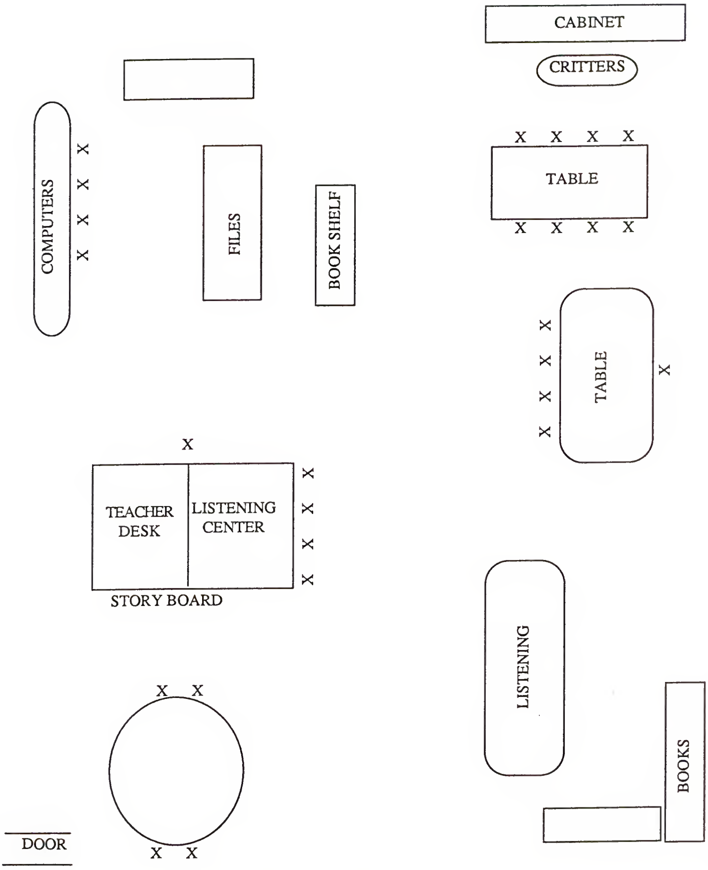
CODES FOR DATA ANALYSIS

CODES FOR DATA ANALYSIS

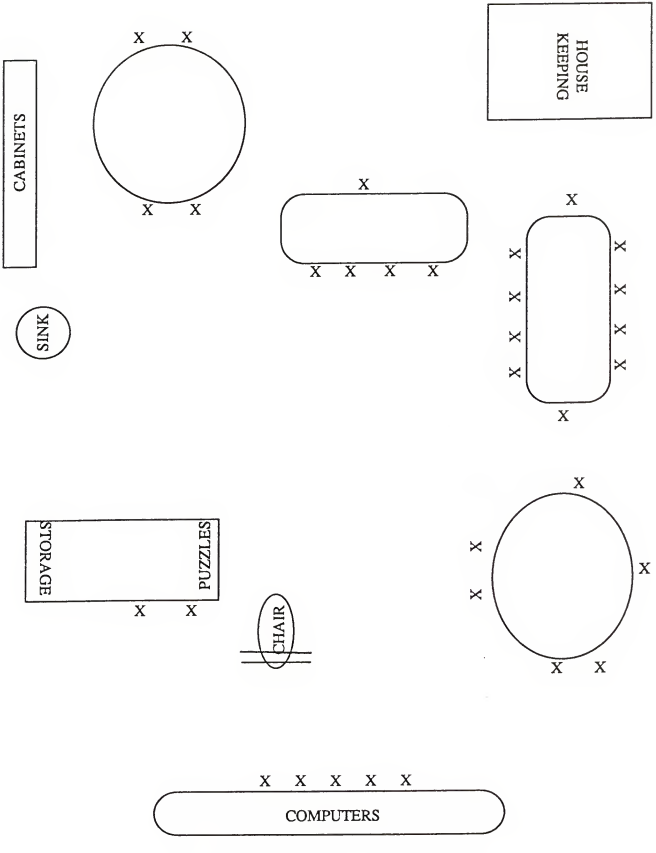
Experience with Computers	
EX: Prior Training in College	EX-PTC
EX: Prior Training on the Job	EX-PTJ
EX: Prior Training, Self-Taught	EX-PTS
EX: Prior Training by Colleagues	EX-PTC
EX: Home Use	EX-HU
EX: No Home Use	EX-NHU
EX: Prior Experience in a Classroom	EX-EC
Experience with TLC	
TLC: Introduction to	TLC-I
TLC: Impression (Positive)	TLC-PIM
TLC: Impression (Negative)	TLC-NIM
TLC: Anticipated Impact on Teaching Style	TLC-ITS
TLC: Expectation of Training	TLC-TE
TLC: Efficacy of Training (Positive)	TLC-ETP
TLC: Efficacy of Training (Negative)	TLC-ETN
TLC: Timeliness of Training Positive)	TLC-TTP
TLC: Timeliness of Training (Negative)	TLC-TTN
TLC: Design of Training (Positive)	TLC-TDP
TLC: Design of Training (Negative)	TLC-TDN
TLC: Materials and Equipment (Positive)	TLC-MEP
TLC: Materials and Equipment (Negative)	TLC-MEN
TLC: Suggestions for Improvement of Training	TLC-SIT
Perceived Effect of TLC on Teaching and Learning	
PEF: Physical Arrangement of Classroom	PEF-PA
PEF: Teaching Schedule	PEF-TS
PEF: Personal Teaching Style (Positive)	PEF-TSP
PEF: Personal Teaching Style (Negative)	PEF-TSN
PEF: Interaction with Colleagues	PEF-IC
PEF: Student Interaction with Computers	PEF-SIC
PEF: Student Achievement (Positive)	PEF-SAP
PEF: Student Achievement (Negative)	PEF-SAN
PEF: Students' Future Success (Positive)	PEF-SFP
PEF: Students' Future Success (Negative)	PEF-SFN
PEF: Teacher Productivity (Positive)	PEF-TPP
PEF: Teacher Productivity (Negative)	PEF-TPN

APPENDIX G

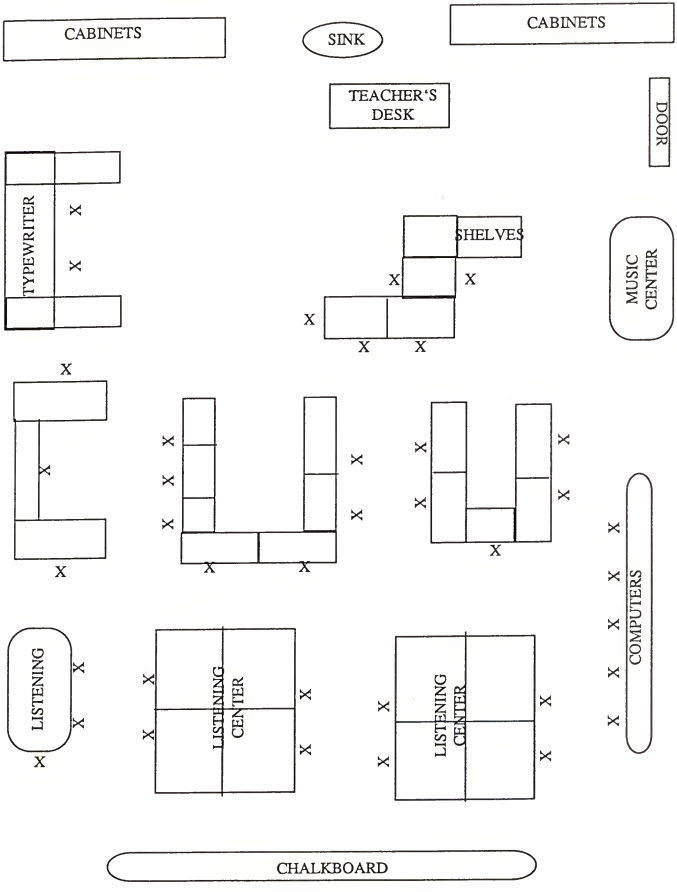
DIAGRAMS OF CLASSROOM ARRANGEMENT



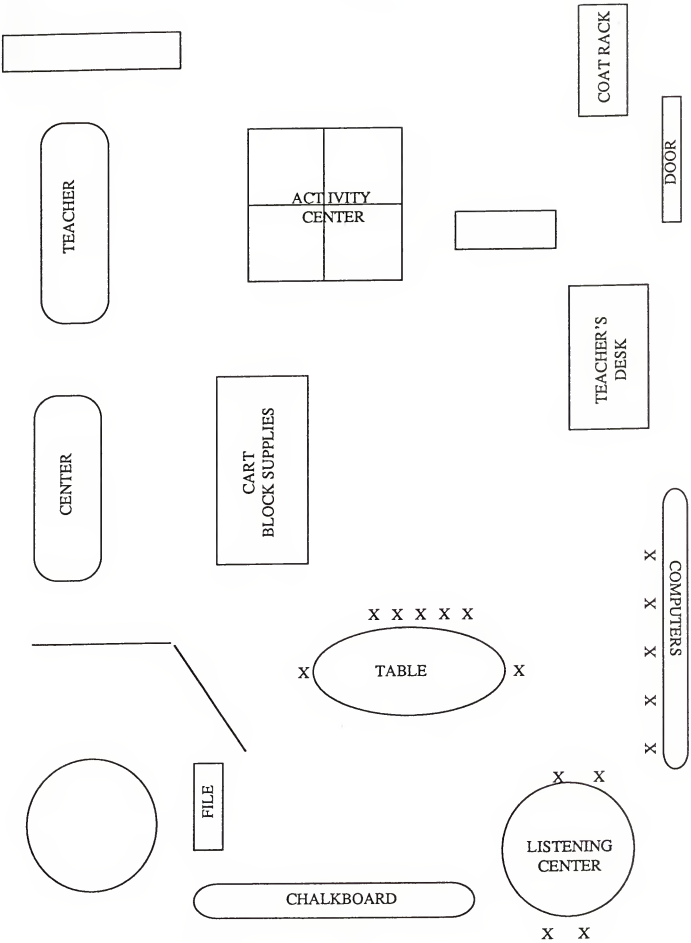
TLC - ORIENTED CLASSROOM #1



TLC - ORIENTED CLASSROOM #2



TLC- ORIENTED CLASSROOM #3



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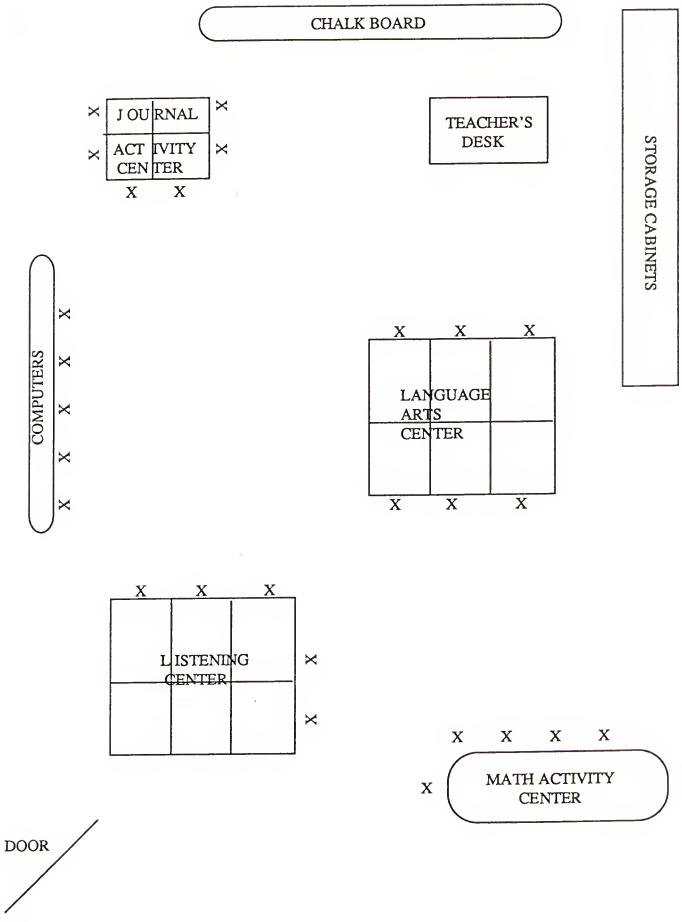
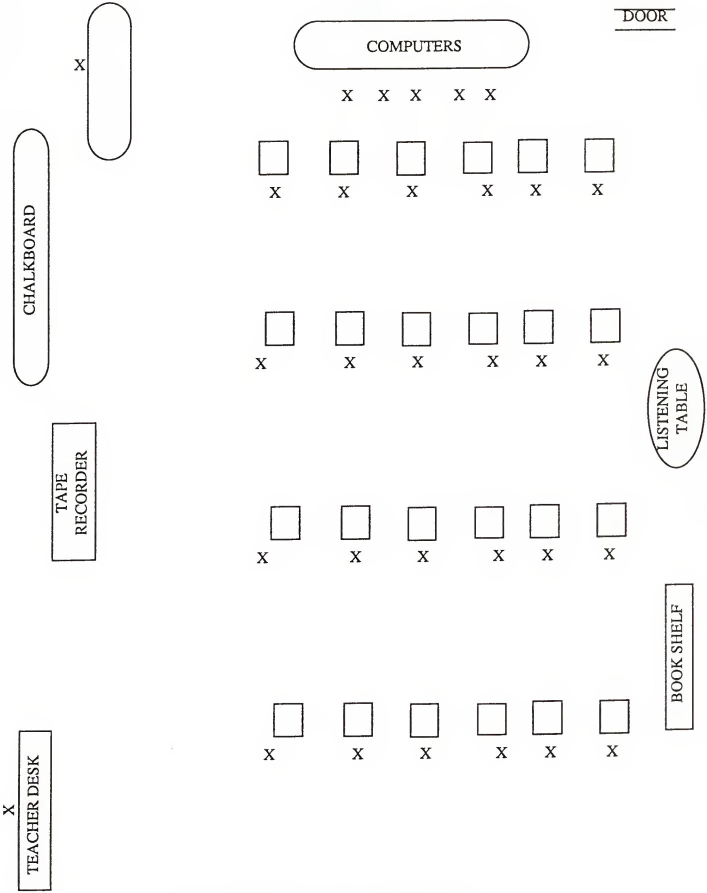
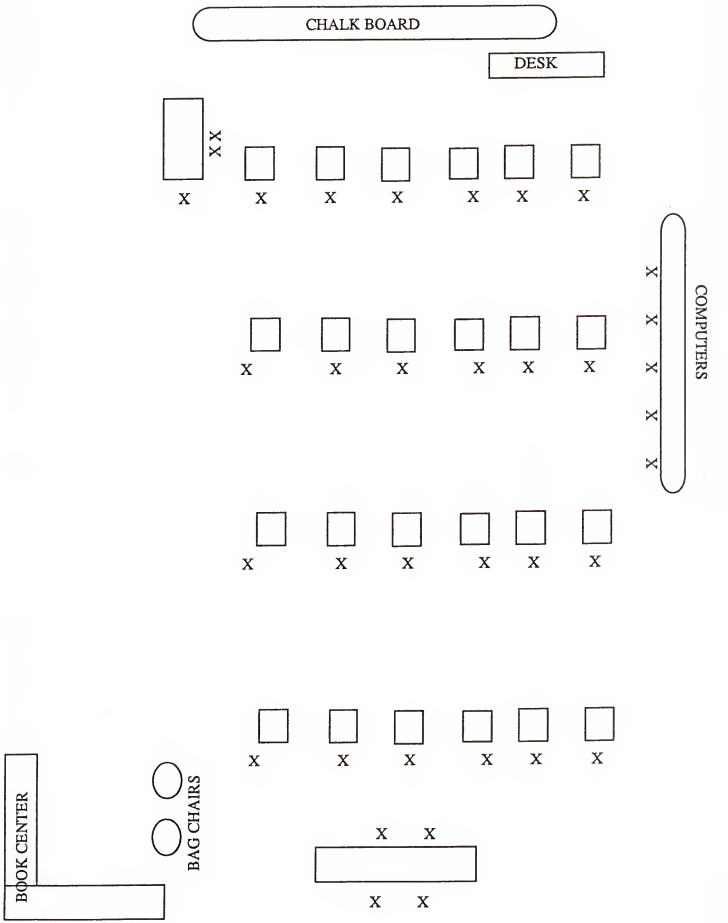


TLC - ORIENTED CLASSROOM #5



TRANSITIONAL CLASSROOM #1



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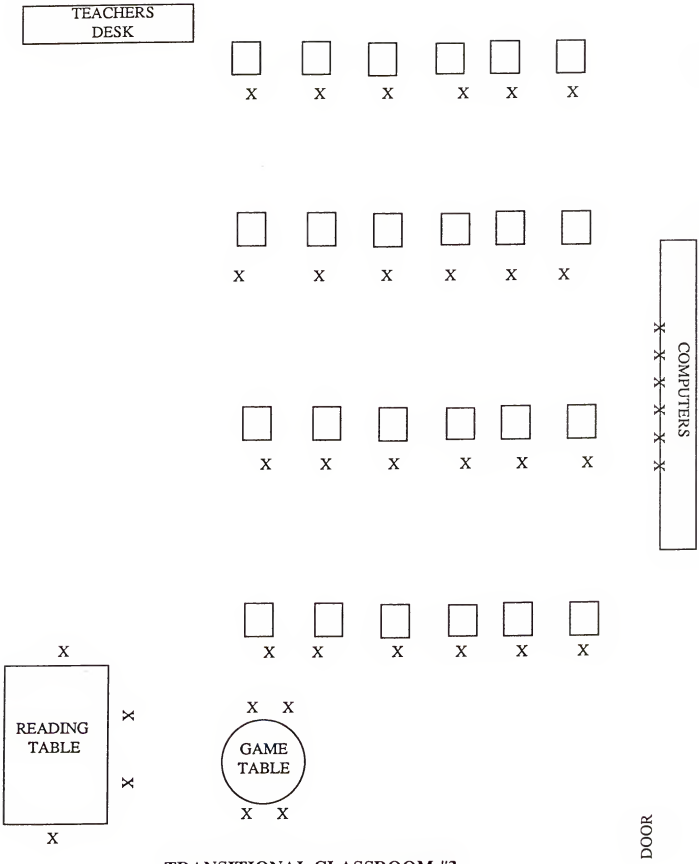
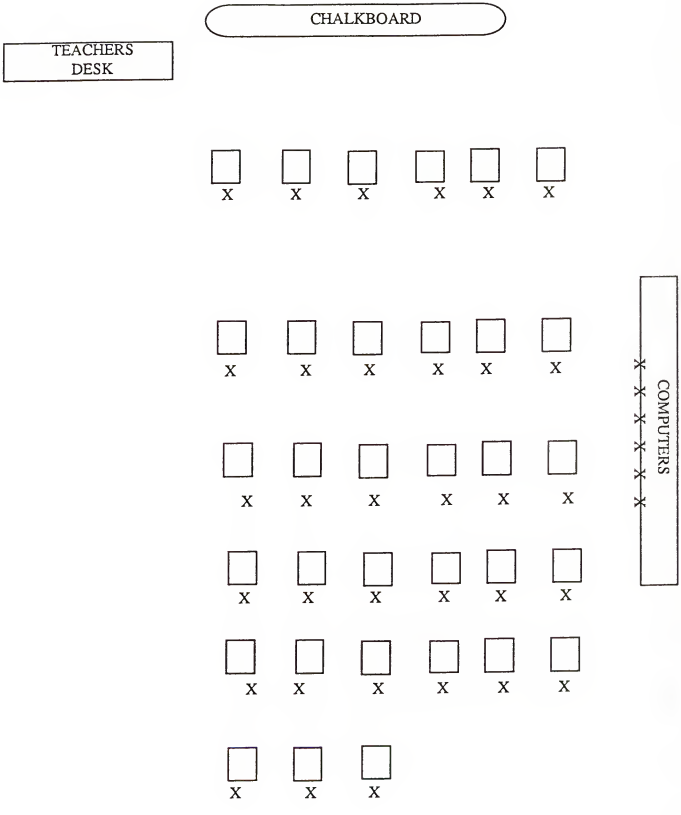


TRANSITIONAL CLASSROOM #3



TRADITIONAL CLASSROOM #1

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BIOGRAPHICAL SKETCH

Mary F. Keating was born in New York City in 1945. She graduated from Indiana University in 1967 with a Bachelor of Music degree in Applied Voice and sang opera, oratorio, and song literature professionally for ten years before settling down to raise a family. Between 1982 and 1994, Mary taught first music, then computer skills, at Reddick-Collier Elementary School in Marion County, Florida. At the same time, she began her graduate studies at the University of Florida, earning a Master's in Music Education in 1987 and a Specialist in Education in Educational Leadership in 1989. In 1994, she became Supervisor of External Funding with the Duval County School Board, Jacksonville, Florida. She currently holds the position of Associate Director, Center for Precollegiate Education and Training at the University of Florida and is on loan to the Department of Music, where she teaches Music for the Elementary Child.

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Education.

John M. Nickens, Chair
Professor of Educational Leadership

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James L. Doud
Professor of Educational Leadership

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David S. Honeyman Jr.
Professor of Educational Leadership

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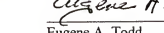

Eugene A. Todd
Professor of Instruction and Curriculum

This dissertation was submitted to the Graduate Faculty of the College of Education and to the Graduate School and was accepted as partial fulfillment of the requirements for the degree of Doctor of Education.

May, 1996

Dean, College of Education

Dean, Graduate School